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SANDSTEN (E. P.) & TOMPKINS (C. M.). **Degeneration in Colorado Potatoes.**—*Colorado Agric. Exper. Stat. Bull.* 278, 15 pp., 8 figs., 1922.

The results of an investigation of the degeneration of Colorado potatoes, carried out during a period of four years with the Russet Burbank and Brown Beauty varieties, at three localities in the State, are described. The potatoes were divided into three series: best hand-selected seed, best culls, and poorest culls obtainable. In 1918 at Del Norte, where the soil is a well-drained, sandy loam, the highest yield in both varieties was obtained from hand-selected seed, followed by the best culls. In 1919, when the experiments were transferred to the heavy clay soil of Paonia, the hand-selected Russet Burbank again gave the best yield; with Brown Beauty, however, the good culls gave the highest yield and the hand-selected seed the lowest. In 1920 at Del Norte the inferior culls of both varieties out-yielded the hand-selected seed. In 1921, at Eagle, where soil and climatic conditions are ideal for potato growing, the best yield was obtained from the hand-selected seed.

The disease factor was almost entirely eliminated in the foregoing experiments, less than 1 per cent. being present in any of the plots during the period. Under Colorado conditions, therefore, degeneration appears to be largely influenced by environmental relations. Degenerate tubers planted in fertile soils in a favourable climate will, with proper attention, produce a superior crop.

It is recommended that every grower should have a special seed plot from which the tubers of high-yielding and disease-resistant plants are dug before the main crop each season and saved for next year's seed plot, the balance or major portion of the seed harvested every year from the seed plot being used for general planting.

GRAM (E.). **Forsøg med avlsstedets indflydelse paa Kartoffelens bladrullesyge.** [Experiments in environmental influence on the leaf roll disease of Potatoes.]—*Tidsskrift for Planteavl*, xxviii, 5, pp. 769–806, 4 figs., 5 diag., 1922.

Experiments were carried on from 1915 to 1920 in various parts

of Denmark under the supervision of the phytopathological service to test the influence of environment on the incidence of leaf roll disease of potatoes. A brief historical account of the disease, together with a full description of its symptoms, pathological anatomy, and the various theories as to its cause, is given in the present paper, and the previous work on its relation to soil, climate, and the like is summarized. The view that the disease is due to an ultramicroscopic organism is accepted. The Danish tests were carried out with one healthy and one diseased strain of Magnum Bonum potatoes, which were cultivated at eleven experiment stations on a variety of different soils. Every autumn samples of each strain from all the stations were forwarded to Kvistgaard in the north of Zealand for further growth and comparison in the following year.

The results of the experiments are described in considerable detail. Tables are given showing the percentage of leaf roll plants each year in the Kvistgaard plots, yield, and other details. Graphs showing the effect of cultivation on the disease, at the different stations are also given. In some of the stations the diseased strain showed a tendency to recover; in others the healthy strain became diseased. On the whole peat soils exerted the most favourable influence on the crop, both as regards yield and freedom from the disease. Sandy soils generally gave excellent results, almost equal to the peat, while both the yield and condition of the crops were adversely affected on light clay, except at one station, where a satisfactory stand was obtained. Heavy clay soils were considerably more favourable than light ones. Possibly the beneficial effects of the peat and sandy soil were due in some measure to the earlier maturity of the plants grown on them, which did not give time for the passage of the virus from the aerial part of the plant through the stolons to the tubers.

The influence of the soil, however, was not found to be the only, or even the most decisive factor in the health or disease of the potato crop. Meteorological conditions played an important part, indeed the influence of climate on the disease appeared to be the predominant factor. Any departure from the normal during the period covered by the experiments was carefully noted. The conditions governing the incidence of aphid attacks and the consequent transmission of leaf roll are discussed. It was observed that damp, cold weather in May and June was followed by a decrease in infection in 80 per cent. of the cases. The absence of disease in the peat soils was probably largely due to the spring and autumn night frosts in these situations, which retarded development in the autumn, and in the spring frequently killed not only the young growth but also the invading aphids. The districts in which these so-called 'sanatorium' soils occur experience an average summer temperature of less than 15·5° C.

The quantity of dry substance present in the tubers is regarded as a further point of some importance. A reduction in the dry substance, believed to result from storage in warm cellars, was frequently associated with a corresponding loss from 'degeneration' in the next year's crop. This is, however, apparently a distinct phenomenon from leaf roll.

Leaf roll may be controlled by procuring seed tubers exclusively from healthy fields, especially from parts of the country where there is little infection. Such methods as field selection and the use of large tubers are unreliable, at any rate in cases of severe infection. The indirect control of the disease by combating the aphids which are responsible for its transmission, the potatoes being sprayed in early summer with Bordeaux mixture and nicotine, is regarded as a promising line of attack. Early lifting of the tubers to prevent infection through the stolons, and the selection of resistant varieties are also worth further investigation.

SHARPLES (A.). **A preliminary account of the fungi causing 'brown root' disease.**—*Malayan Agric. Journ.*, x, 7, pp. 181–183, 1922.

During 1920 numerous cases of brown root disease were observed on *Hevea* rubber trees on a Malayan estate. The chief symptom was the well-known incrustation of the roots with masses of earth and stones. Previous to 1917 the causal fungus of this disease was referred to *Hymenochaete noxia*, but during that year Petch obtained numerous fructifications of *Fomes lamaoensis* from tea and rubber plants killed by brown root disease, and stated that the so-called *Hymenochaete* was merely the result of abortive attempts at the development of the *Fomes* sporophore.

Pure cultures on rubber wood blocks were obtained by the author from the diseased roots mentioned above. At the same time the fungus causing brown root disease of camphor (*Cinnamomum camphora*), a large patch of which has been slowly dying out for years at Kuala Lumpur, was isolated. The cultures were so distinct that they could scarcely be regarded as belonging to the same fungus as the last. Further cultures were obtained from typical specimens of brown root disease of *Hevea* rubber roots received from Ceylon, and these again gave a fungus obviously different from the other two. In every feature the three sets of cultures were readily distinguishable from one another, except that they had the peculiarity in common of secreting mucilage by the hyphae when in contact with water. There can be little doubt that this process accounts for the typical symptoms of brown root disease, the secretion of mucilage causing the binding together of the encrusting mass of earth and stones.

Thus there are at least three morphologically different, though physiologically comparable, fungi associated with brown root disease. The camphor and the Ceylon rubber brown root fungi in their final stages exhibit characters considered typical of the genus *Hymenochaete*, while the Malayan rubber brown root organism appears to be forming fructifications resembling those of a *Corticium*. Further details regarding these fungi will be published subsequently.

OSBORN (T. G. B.) & SAMUEL (G.). **Some new records of fungi for South Australia, Part II, together with a description of a new species of Puccinia.**—*Trans. Roy. Soc. S. Australia*, xlvi, pp. 166–180, 1 pl., 4 figs., 1922.

In this paper records are given of fifty-one fungi new to the

South Australian flora, of which one, *Puccinia semibarbatae* on *Bulbine semibarbata*, is new to science.

Amongst species parasitic on cultivated plants the following are of interest:

*Phoma macrophoma*, *Diplodia citricola*, *Septoria depressa*, and *Coniothecium scabrum* on orange, the first on the twigs, the other three causing scabbing of the fruit; *Phyllosticta brassicicola* on *Brassica oleracea*; *Septoria lycopersici* on tomato; *Vermicularia circinans* [*Colletotrichum circinans*] on onion; *V. varians* ('black dot' or dartrose disease) on potato; *Gloeosporium ribis* on gooseberry canes and leaves; *Cercospora apii* causing a leaf spot of parsnips (*Pastinaca sativa*); *Coniothecium chomatosporum* causing cankers on twigs of apple and pear, scabbing of fruit has so far not been recorded in South Australia; *Pseudomonas juglandis* on stems, leaves, and fruits of walnut (*Juglans regia*), a serious disease which has spread to almost all places where walnuts are grown, and which makes it impossible to obtain a marketable crop from many trees; *Bacterium mori* causing angular, black spots on the leaves of mulberry (*Morus nigra*).

*Plasmopara viticola*, which appeared first in Australia at Rutherglen, Victoria, in the season 1916–17, spread eastward, reaching Queensland in 1920–21. Its progress to the west was slow, its occurrence in Mildura being only reported in the season 1920–21, and from thence it spread down the Murray to Renmark, Berri, and Waterdale. It is possible that infection may have been conveyed by human agency as there is regular motor traffic between Mildura and Renmark, but the spread is thought to be more probably due to air-currents, though the distances involved are considerable, varying from 100 to 230 miles. The attacks in South Australia have so far been slight, and it is not thought that climatic conditions will favour the development of the fungus.

OSBORN (T. G. B.). **A note on the pathological morphology of Cintractia spinificis (Ludw.) McAlp.**—*Trans. Roy. Soc. S. Australia*, xlvi, pp. 1–5, 1 pl., 5 figs., 1922.

This smut causes certain interesting pathological changes in the host [*Spinifex hirsutus* Labill].

In the male inflorescence, instead of the normal spikelet composed of two sterile glumes, or three sterile and one flowering, and with each floret consisting of glume, palea, two lodicules, and three stamens, the smutted spikelet has two sterile glumes and two florets, the latter being without lodicules. The anthers of the smutted flower contain no pollen and the filaments do not elongate. Above the point of insertion of the stamens an irregular conical mass, 1 to 7 mm. in length, is produced, consisting of a central core of host tissue coated, in the ripe smut gall, with a spore layer. Other changes are the greater elongation of the internodes of smutted inflorescences, reduction in the number of secondary axes in the inflorescence, closer aggregation of spikelets, and increase in their number per secondary axis.

The main divergences of a diseased female inflorescence from the normal are elongation of the internode below the terminal head, complete absence of the long sterile spines which are so marked a feature

of the normal inflorescence (a few sterile spines may be present, but these are shorter than the fertile spines, of which the head is largely built up), insertion of the spikelets on the fertile spines at a distance of 1·5 to 4 cm. from the base instead of being borne at the extreme base, and increase in length of the spines themselves up to 15 cm. in length (i. e. half as long again as normal). The smutted female spikelet consists of two sterile and two fertile glumes, as against three sterile glumes (or two sterile and one abortive male flower), and one fertile glume in the normal spikelet. The lower floret, normally an abortive male, behaves like a female in the smutted heads and is indistinguishable from the upper, fertile one. The smutted flower has glume and palea, both longer than usual, the latter being often involved in the smut gall, but no stamens have been recognized, the whole of the floral axis above the palea being an elongated, rarely bifurcated, smutty mass.

The smut galls in both the male and the female inflorescences are similar, except that the former is usually somewhat smaller. Owing to the extensive modifications produced by the gall formation, however, it is not safe to conclude that ovaries are actually produced in male flowers as a result of the attack, as has been reported in the case of certain other smuts.

TROTTER (A.). **Osservazioni intorno ad alcuni Erisifacei italiani meno noti.** [Notes on some less-known Italian Erysiphaceae.] —*Ann. R. Scuola Sup. di Agric. in Portici*, 2nd ser., xvii, pp. 3–11, 1922.

Notes are given on three Erysiphaceae of economic importance as well as of scientific interest, observed in Italy.

The appearance and wide dissemination of the oak mildew in Europe is described, and the records of the discovery of its perithecial stage in various parts of Europe discussed. The author has examined perithecia found in Sicily late in 1920, and states that they agree with previous French and Italian records, except in the somewhat smaller size of the asci and ascospores. He identifies the fungus as *Microsphaera quercina* (Schw.) Burr., a species grouped by Salmon under *M. alni*, and referred by Neger to *M. alni* var. *quercina*. The almost simultaneous appearance of the ascigerous stage in France, Germany, and Italy he regards as being due not to any special climatic influences, but to internal causes in the fungus itself, probably connected with its acclimatization.

American gooseberry mildew (*Sphaerotheca mors-uvae*) appears to have been actually first recorded in Italy by Voglino in the province of Turin in 1904, but this record has escaped most recent writers. The fungus is now present in Turin, Pavia, Milan, Venetia, Novara, and other districts, and even far to the south in Avellino. The cultivation of gooseberries is, however, so limited and scattered that serious economic losses are not to be anticipated.

Apple mildew has received scant notice in Italy, though it is present not only in the north of the country, but also, apparently of recent introduction, in Avellino. There is no doubt that the disease is widely diffused in its conidial form in Italy. The ascigerous stage appears to be seldom developed, and there is accordingly some doubt as to the species concerned. It is not

improbable that the two fungi, *Podosphaera leucotricha* and *P. oxyacanthae*, occur in Italy, but in the Avellino cases examined by the author the conidial stage could not be referred to the latter, and *P. leucotricha* was probably concerned. The disease appears to be increasing in Italy, its spread being assisted by the use of infected wild apple seedlings from northern Italy as stocks. It was noticed that wild apples grown from seed were severely attacked whereas after grafting they were almost immune.

NANNIZZI (A.). **Sulla forma ascofora dell' Oidium quercinum Thüm.** [Notes on the ascigerous form of *Oidium quercinum* Thüm.]—*Riv. Patol. Veg.*, xii, 7–8, pp. 87–90, 1922.

The author records the finding of perithecia of the oak mildew in the Sienna district. He agrees with views expressed by some other Italian observers that their development was induced by a sudden lowering of the temperature after a prolonged heat wave. They were chiefly on mature leaves, which were covered with them, but numerous examples occurred also on young leaves at the tips of the shoots. Only *Quercus pedunculata* bore them, *Q. sessiliflora*, *Q. cerris*, and *Q. ilex* having no perithecia, though their leaves bore the conidial stage.

The perithecia, which are referred to *Microsphaera quercina*, agreed in their main characters with the previous Italian descriptions.

PETCH (T.). **Some diseases of Tea.**—*Trop. Agric.*, lix, 4, pp. 243–249, 1922.

A leaf disease due to *Cercosporella theae*, which was not observed between 1909 and 1919, has attracted much attention in up-country districts in Ceylon, since the latter date [see this *Review*, i, p. 331]. The disease, which is almost invariably found in the neighbourhood of acacias, appears towards the end of the monsoon rains, first on the acacias and then spreading to the tea; it is found mostly at altitudes above 4,000 ft. Numerous black spots are produced on the young leaves, and in wet weather the whole leaf may become black and rotten. On older leaves the spots are at first black, and then may turn grey, with a raised, purple border. Full-grown leaves are marked with large, diffuse, mottled brown patches, which turn grey with age and have a narrow, purple-black, marginal band. In severe cases the bush may be almost defoliated. Attacks on the green stems occur in the form of purple, sunken areas. The fungus is visible as a fine, white web over the spots and on the surrounding areas of the under surface of the leaf. The long, rod-shaped spores are borne on this superficial mycelium in white clusters. The return of fine weather after the rains arrests the disease.

A stem disease caused by *Aglaospora aculeata*, formerly somewhat rare, appears also to be on the increase. It is believed to be confined to the up-country districts. The fructifications of the fungus are formed beneath the bark, the outer layers of which eventually crack as a result of pressure from within. The apices of the fructifications protrude through the fissures as conical, black thorns, arranged in straight lines or circles. The wood of infected branches is dark brown in colour, and brittle but not soft. Unless

checked, the fungus spreads into the main stem and may even travel down to the roots, ultimately killing the bush. Infection is conveyed by means of spores extruded from openings at the apices of the thorns. The stems are apparently infected at pruning cuts. Tea is so far the only known host of the fungus. The dead branches should be removed and burnt, but the complete eradication of the fungus often involves collar pruning.

Red root disease (*Poria hypolateritia*), the symptoms of which are described in detail, is very common in young clearings, originating on the stumps of Bombu [*Symplocos spicata*], Doon (*Doona zeylanica*), and other jungle trees. Directions are given for the eradication of the fungus, which has been known to destroy over two thousand bushes in an area of twenty-six acres in six years.

Acacia stumps are liable to attack by various large root and stem fungi, e. g. *Fomes applanatus*, *Armillaria fusipes*, and *Irpex destruens*, all of which are capable of attacking tea. Acacias are now extensively used for interplanting with tea, and, in view of the danger of infection by these fungi, the stumps should be extracted whenever possible if it becomes necessary to remove the trees.

SIDENIUS (E.). **Verslag van het Deli Proefstation over 1 Juli 1921—30 Juni 1922.** [Report of the Deli Experiment Station from 1st July 1921 to 30th June 1922.]—*Meded. Deli Proefstat. te Medan-Sumatra*, Ser. 2, xxiv, 64 pp., 1922.

Experiments were conducted to test the value of *Mimosa invisa* when used as a green manure for tobacco in reducing the incidence of slime disease [*Bacillus solanacearum*]. Observations and investigations of many years' duration had already shown that *M. invisa* not only improves the soil but also suppresses the development of the hosts of *B. solanacearum*. It has the further advantage of being easily and inexpensively cultivated, though it is subject to sporadic attacks from *Sclerotium rolfsii*. The recent tests showed that no marked improvement can be expected unless the *Mimosa* is grown for a year or more before being ploughed under. The effects on the slime disease of liming the soil were also studied. Negative results were obtained, except in one plantation of loose red soil containing quartz, where the application of three tons of lime per bouw [1·79 acre] reduced the infection from 33 per cent. to 6 per cent. The incubation period of slime disease on tobacco was found to be approximately six days for seedlings about 5 cm. in height, ten days for seedlings ready for transplanting, and eleven to thirty days for plants in the field.

The practice of hilling is frequently held responsible for the aggravation of slime disease, but experiments proved that this is not the case. Hilling was, moreover, found to be indispensable to the proper development of the crop. Seedlings from healthy beds sown in infected ground were found to be considerably less susceptible to slime disease than apparently sound and strong seedlings from infected beds (30·8 per cent. of infection as against 41·1 per cent.). Tests of varieties selected for resistance to this disease were continued. Promising results were obtained with one of the selections, and it is proposed to carry out extended tests of this strain.

*Phytophthora* [*nicotianae*] was prevalent on tobacco seedlings ready for transplanting, probably on account of the heavy rains while the plants were in the seed-bed. *Ricinus communis* was attacked by an allied and possibly identical species of *Phytophthora*.

Specimens of field tobacco submitted for examination were found to be attacked on the stalks by a species of *Pythium*. On two estates the epidemic was so severe that scarcely a single plant remained healthy. Both the sites in question were formerly occupied by cattle-sheds. The application to the transplant holes some days before planting of a 1 : 500 solution of formaldehyde greatly reduced the infection. Treatment with uspulun was ineffectual.

RAMSEY (G. B.). **Basisporium gallarum Moll., a parasite of the Tomato.**—*Bot. Gaz.*, lxxiv, 3, pp. 325–328, 11 figs., 1922.

A rot of ripe tomato fruit shipped from California in 1919 was found to be due to *Basisporium gallarum*, a fungus originally observed by Molliard on dead larvae of *Lipara lucens*, within galls which this insect produces on *Phragmites communis*. Although the presence of *Basisporium* in cultures from maize, wheat, and dewberries has since been reported, no parasitic activities appear to have been attributed to it previously. Inoculation experiments indicate that it is a vigorous wound parasite which produces soft, red, blister-like lesions on ripe tomato fruits. The lesions may reach a diameter of two inches in four days. Green fruits react to the inoculation, but in a lesser degree, while a temperature of 9° to 10° C. inhibits the development of the fungus even on ripe wounded fruit. An abundance of pale, smoke-coloured mycelium develops on the fruit when the latter is kept in a humid atmosphere after inoculation.

Cultural experiments are described, which show that the extreme temperatures for growth are approximately 10° and 35° C. Although the Californian fungus exhibits a few minor morphological differences from the description of Molliard's form, and the substrata on which the two were found differ widely, the author does not feel justified in creating a new species for this tomato parasite.

TROTTER (A.). **Intorno al seccume degli aghi ed agli altri fenomeni patologici del Pino domestico (Pinus pinea L.).** [Notes on needle blight and other pathological phenomena of the Stone Pine (*Pinus pinea* L.)]—*Riv. Patol. Veg.*, xii, 7–8, pp. 91–106, 4 figs., 1922.

The needle blight of the stone pine (*Pinus pinea*) in Campania may be due to physiological causes (as in the vicinity of Vesuvius, where the gases emitted from the crater affect the trees) or to the attack of parasitic fungi. The author describes a case of the latter from near Avellino, where it is sometimes epidemic. Towards the end of spring the needles turn light green in colour, later becoming yellow, and then brown as they dry up. Those situated near the tips of the twigs are most affected, and a high proportion of shoots is usually involved, so that the disease is very noticeable. The symptoms on the individual needles vary: the apex may be

yellowed and withered, the base remaining green for a time; the needles and their sheaths may dry up uniformly; there may be nothing more than a slight contraction of the tissues or a discoloured spot resembling a bruise; drops of resin may exude, especially towards the base and on the sheaths; and finally, the presence of blackish dots may be observed on the surface of the needle and its sheath and on the adjacent epidermis of the twig. These dots are the fructifications of two distinct fungi, a *Pestalozzia* and a *Cladosporium*. The former is considered to be a new form, f. *pini-pineae*, of *Pestalozzia hartigii*, resembling most closely *P. truncata* Lév. amongst the other species of this genus found on conifers. Its mycelium penetrates the needles as fine, hyaline hyphae, 2 to 2·5 $\mu$ in diameter and much more sparingly septate, less tortuous, and less branched than those of the *Cladosporium*. The conidia are borne on a stromatic layer of gelatinous, interwoven hyphae, and are difficult to find.

The *Cladosporium* is regarded as a new form, f. *pini-pineae*, of *C. laricis*, previously only known on the larch. It differs from the normal type chiefly in attacking the sheaths, and sometimes even the twigs, as well as the needles, which alone are attacked in the larch. Fructifications are found more readily on the sheaths than on the needles; on the latter usually only small stromata, occupying the substomatal cavities and protruding very slightly from the stomata, are formed. The mycelium is confined to the outer parenchyma of the needles.

The exact part played by these fungi in the production of the needle blight described in this paper has not been established. Frost is believed by the author to be an important factor in the disease, which is much more prevalent at an altitude of 600 m. than near the town of Avellino, which is only 300 m. above sea-level.

An annotated bibliography of fifty-nine references to diseases, pests, and teratological phenomena affecting the stone pine is appended.

STEUP (T.). **Een ziekte (Aecidium cinnamomi Rac.) van den Tedjo (Cinnamomum iners Bl.).** [A disease (*Aecidium cinnamomi* Rac.) of Tedjo (*Cinnamomum iners* Bl.).]—*Tectona* [Buitenzorg, Java], xv, 4, pp. 348–350, 1922.

Tedjo (*Cinnamomum iners*) trees at Batoe Raden examined in 1919 were found to be in a withered and dying condition. The leaves, petioles, and branches, especially of the upper part of the tree, and sometimes also the trunk, were affected. The diseased leaves and twigs exhibited a black discoloration, the latter also becoming noticeably swollen.

All the affected parts were covered with the orange-coloured aecidia of *Aecidium cinnamomi* Rac. Unless subsequent investigations prove that the form occurring on *C. iners* is biologically restricted to that host, there is every likelihood that the disease may spread to the cultivated cinnamon [*C. zeylanicum*]. Pending further investigations, the only control measures which can be suggested are the excision and burning of all affected parts.

SAMUEL (G.). **Notes on forest pathology from South Australia.**—*Australian Forestry Journ.*, v, 7, pp. 189–192; 8, pp. 223–226; and 9, pp. 253–254, 7 figs., 1922.

The author, while stating that at present parasitic diseases are of no great importance in South Australian forests, calls attention to the neglect throughout Australia of forest pathology which may well lead to the introduction of new pests from abroad or to the dangerous development of hitherto negligible diseases already present in the country. He advocates, therefore, the appointment of at least one qualified forest pathologist, whose duty would be to protect the interests of sylviculture.

The main interest of these papers lies, however, in the description of a remarkable disease, locally known as 'curly-needle disease', of *Pinus muricata* and *P. insignis* observed at Kuitpo, South Australia, but stated to exist also in Victoria and Western Australia. The most characteristic symptom is the effect on the leaves. The three needles in each group are often fused together, curved, and shortened; the thickened compound needle may be not more than a third of an inch in length. Sometimes the needles are united without being shorter than usual, and the different degrees of deformity may be found, together with normal needles, on the same tree or even on the same year's growth. A less constant symptom is the elongation and greening of the bracts subtending the needle bunches; this is less frequent and less pronounced in *P. insignis* than in *P. muricata*, in which the bracts may become $1\frac{1}{2}$ in. long and $\frac{1}{8}$ in. wide at the base. In the latter species the dead male cones are often retained in large numbers on the affected trees for a considerable time. The disease develops in trees up to six years old, after which age they appear to be immune. The symptoms frequently arise in trees apparently growing strongly, but the result is invariably to arrest or greatly retard further growth. Old cases have a peculiarly tufted appearance due to copious branching of the lateral shoots. In *P. insignis* the leading shoot and some of the side branches may be killed outright. There seems to be no regularity in the distribution of affected trees; although occasionally two or three may occur together, it is far more usual to find a diseased tree surrounded by perfectly healthy ones. No correlation has so far been established between the occurrence of the disease and soil or other environmental conditions, and its cause is as yet entirely unknown. It has been suggested that it is the result of the attacks of *Chermes*, and that an aphis is embedded in the tissue at the base of each curly-needle bunch, but the author was unable to discover any grounds for this belief. He was also unable to find any fungus constantly associated with the disease, and many of the symptoms are directly at variance with those usually connected with fungous diseases. The disease is considered to have points in common with the group of physiological diseases of which tobacco leaf curl is a type; the latter is hereditary and transmissible by insects and inoculation, though it is not caused by any known fungus or bacterium.

Brief notes are also given on the effects of the 'smothering fungus' *Thelephora terrestris* (*T. laciniata*) and of *Armillaria mellea* on *Pinus insignis*, as well as a short account of a shoot disease associated with a fungus of the *Fusicoccum* type.

BIRMINGHAM (W. A.). **Disease of Pinus insignis at Strickland State Forest, Natara.**—*Australian Forestry Journ.*, v, 8, pp. 206–211, 5 figs., 1922.

The author gives a detailed description of a disease of *Pinus insignis*, found at Natara, New South Wales, which is evidently, in part at least, the same as that referred to in the above abstract as 'curly-needle'. Inoculation experiments made with two species of fungi (*Sphaeropsis* and *Pestalozzia*) that were common on the dead needles gave negative results, and the disorder is believed to have a physiological origin. An additional symptom besides those mentioned by Samuel is the development of a long main axis free from lateral growth and with a mop-like head. A profuse development of needles along the main axis may also occur.

MÜLLER-THURGAU (H.). **Die Gloeosporium-Krankheit der Holunderbeeren.** [The *Gloeosporium* disease of Elderberries.]—*Landw. Jahrb. der Schweiz*, xxxvi. 6, pp. 826–828, 1922.

The causal organism of a widely distributed disease of elderberries (*Sambucus nigra*) was isolated and found closely to resemble *Gloeosporium fructigenum* [*Glomerella cingulata*], which produces bitter rot of apples. Cross-inoculation experiments with the elderberry organism and *G. fructigenum* were undertaken, the results of which showed that the elderberry *Gloeosporium* was incapable of infecting apples. Elderberries inoculated with *G. fructigenum* from apples were eventually infected, but only when their skin had become ruptured after standing in water for some time. Ripe berries of *Sambucus ebulus* were also proof against the attacks of the elderberry *Gloeosporium*.

Notwithstanding the morphological agreement between *G. fructigenum* and the elderberry organism, the author thinks that the latter must be regarded as a biological variety, for which the name *G. fructigenum* var. *sambuci* is proposed.

LINDFORS (T.). **Studier över Fusarioser. II. Om Fusariumangrepp på späda Barrträdsplantor.** [Studies in Fusarioses. II. *Fusarium* attacks on Conifer seedlings.]—*Centralanst. för försöksväsendet på jordbruksområdet Medd.* 238, 24 pp., 1 col. pl., 4 figs., 1922. (German summary.)

After a brief discussion of previous work on the damping-off of conifer seedlings, the author describes his experiments with *Pinus sylvestris* in 1916 and 1917. In the first isolations made from material submitted for examination from Osby [south Sweden], only one species of *Fusarium* (a form resembling *F. redolens* except that it produced sporodochia and pionnotes sparingly, had many 4- to 5-septate conidia, and bore chlamydospores) was found. In a later experiment with seedlings grown in sterile soil in pots, a spontaneous outbreak of *Fusarium* occurred and five species of the genus were isolated from twenty seedlings, namely, *F. metachroum* from ten plants; *F. subulatum*, *F. solani*, and *F. microxysporum* n. sp. each from three; and *F.* cf. *sclerotioides* from two. This last species agreed in the main with *F. sclerotioides* var. *brevius* (*F. blasticola*), but differed in the production of 4- and 5-septate conidia, and in the size and number of the sclerotia. The

new species, *F. macroxysporum*, of which a Latin diagnosis is given, is allied to *F. euoxysporum*, from which it differs in the greater breadth of the conidia, and also to *F. aurantiacum*, from which it may be distinguished by the rarity of conidia with more than three septa and the absence of blue sclerotia. Its mycelium rapidly becomes covered on most substrata with a layer of conidia resembling pionnotes. The few sclerotia which occur are light brown in colour. On rice and wheat flour cake the plectenchyma assumes a diffuse purple coloration. The conidia are generally 3-, but sometimes 4- and 5-septate, while in older cultures microconidia occur, continuous or with one or two septa, and chlamydospores, both intercalary and terminal, are also formed.

Inoculation experiments with these six species and also *F. culmorum* and *F. subcarneum* were carried out on pine seedlings grown in sterilized soil in pots. The most severe attacks were caused by *F. metachroum*, *F. subulatum*, *F. culmorum*, and *F. macroxysporum*, but in all the inoculated pots the number of diseased seedlings was greater than in the controls. The author isolated from various soils all the pathogenic species of *Fusarium* mentioned above, with the exception of the species resembling *F. sclerotioides* and *F. redolens*, while infection was also proved to be transmitted by the seed. Steeping the seed for fifteen minutes in 0·1 per cent. formalin reduced infection from this source to a minimum. Further experiments were undertaken to ascertain the effect of soil sterilization both on the host and on the parasites used in the above experiments. The germination of the seed and growth of the seedlings was found to be, if anything, improved when sterilized soil was used, and some of the fungi also grew better in the extract from sterilized than in that from unsterilized soil. In inoculation experiments with *F. macroxysporum* a much larger number of seedlings became diseased in the former than in the latter soil.

The methods of control advocated by other investigators are summarized, no work on these lines having been undertaken by the author himself. They include disinfection of the soil with sulphuric acid, formalin, copper sulphate, or zinc chloride, all of which have given satisfactory control in various places, and steeping the seed in copper sulphate, corrosive sublimate, or formalin. From statements in the literature it would appear that *Abies concolor*, *Pinus ponderosa*, *P. sitchensis*, *P. pungens*, *Picea engelmannii*, and *Larix leptolepis* are very susceptible to damping-off, while *Picea excelsa* is almost immune. Neger's statement that the common pine (*P. sylvestris*) is also almost immune is contradicted by the present investigations in which it proved extremely susceptible.

MORQUER (R.). **Sur un nouvel hôte du Trametes hispida (Bagl.).** [On a new host of *Trametes hispida* (Bagl.).]—*Bull. Soc. Myc. de France*, xxxviii, 3, pp. 170–172, 1922.

The author describes the occurrence of *Trametes hispida* [*T. trogii* Berk.] on *Schinus dependens*—apparently a new host—in the Botanical Gardens of Toulouse. The mycelium was found to follow the axis of the trunk to a considerable distance (about 1 metre) occupying the medullary region and penetrating radially

into the surrounding wood for 2 to 3 cm. from the pith. This resulted in the formation of a continuous strand composed of wood fibres interwoven with the mycelium. At certain points the latter reached the surface and produced fructifications. The affected areas were yellowish-white, in contrast to the pale pink of the healthy wood.

The diseased wood was spongy in texture, the fragments softened by the action of the fungus possessing a certain amount of elasticity; the wood fibres were also easily dissociated. At the margin of these softened areas, brown, sinuously concentric zones were formed, probably as a result of the action of oxydizing enzymes whose presence was demonstrated by the author.

The fungus was successfully isolated and grown in culture, details of which are given. Sporophores do not appear to have been formed in culture.

MANNS (T. F.). **Cabbage wilt and stem rot in Delaware.**—*Delaware Agric. Exper. Stat. Bull.* 132, 24 pp., 13 figs., 1922.

Cabbage wilt or yellows, due to *Fusarium conglutinans*, and stem or foot rot (*Phoma lingam*) have caused heavy losses to Delaware growers during recent years. The symptoms of the diseases are described and figured, the trouble in both cases being traced to the seed-bed. Investigations were carried on from 1914 to 1917 to ascertain whether the yellows resistant strains selected by L. R. Jones in Wisconsin from the variety Ball Head were of any value in Delaware. The results of these experiments were, on the whole, not very promising. It was found, however, that desirable wilt-resistant strains, of both early and late varieties, could be produced on wilt-sick land by the following method. Duplicate seed-bed rows were planted forty-two inches apart, the non-resistant seedlings being thinned out until a uniform stand of highly resistant plants was secured. The latter were finally thinned out to a distance of one foot apart. The varieties that gave good results under these conditions were Jersey Wakefield, Drumhead Frost Proof, and Nokor or Volga. Resistance to wilt does not ensure the absence of stem rot.

The following control measures are recommended: rotation of crops, disinfection of the seed with corrosive sublimate, and a liberal application of well rotted manure combined with a potassium fertilizer.

MILBRATH (D. G.). **Alternaria from California.**—*Bot. Gaz.*, lxxiv, 3, pp. 320–324, 2 figs., 1922.

A disease of cabbage, cauliflower, and broccoli, confined to a district of California where high relative humidity and a uniform temperature prevail, was found to be due to an apparently undescribed species of *Alternaria*. Its chief symptom is the appearance, generally on apparently vigorous leaves of all ages, of numerous circular, somewhat sunken, purplish-black spots, the centres of which are darker than the margins. The zonation characterizing the lesions produced on leaves of cabbage by *A. brassicae* is lacking. Sporulation of the fungus is sparse on still vigorous leaves, but becomes profuse on yellow and detached leaves.

Cultures were readily obtained and the disease reproduced by inoculation. Under dry conditions in the field only a small speck developed, but large spots up to 1 to 1·5 cm. were produced in seven days in plants kept in a very moist atmosphere. In view of the differences in morphological characters between this fungus and *A. brassicae*, and its different effects on the host, the author names it *A. oleracea* n. sp., a full English description being given.

OSTERWALDER (A.). **Ein Rotbrenner-Bekämpfungsversuch.** [An experiment in the control of 'Rotbrenner'.]—*Landw. Jahrb. der Schweiz*, xxxvi, 6, pp. 831–832, 1922.

As a rule the liberation of the spores of the 'rotbrenner' fungus (*Pseudopeziza tracheiphila*) takes place during the latter half of May. A severe epidemic of the disease in 1918 led to a series of experiments in its control in the following spring, especially on the susceptible Müller vines. It was found that spraying with 1·5 per cent. Bordeaux mixture reduced the amount of infection to a minimum. The application of the mixture took place on 6th June 1919, but such a delay was only possible on account of the dry, hot weather of that year. In general, about the 20th May would be an appropriate date in the Wädenswil area.

MÜLLER-THURGAU (H.), OSTERWALDER (A.), & JEGEN (G.). **Pflanzenphysiologische und pflanzenpathologische Abteilung.** [Department of Plant Physiology and Pathology.]—*Ber. Schweiz. Versuchsanst. für Obst-, Wein-, und Gartenbau in Wädenswil, 1917–20. Landw. Jahrb. der Schweiz*, xxxvi, 6, pp. 774–784, 1922.

This short review of the diseases of orchard, vineyard, and garden crops observed in Switzerland during the years 1917–1920, contains many records of interest.

Amongst fruit diseases it is stated that the quince disease caused by *Sclerotinia linhartiana*, which was formerly very prevalent, appears to be declining in importance, while *Entomosporium maculatum* [*Fabraea maculata*] seems to be on the increase and causes considerable damage to this host. Quince mildew (*Oidium cydoniae*) was also recorded. *Xylaria polymorpha* was found on the collar of a diseased pear tree, and the white spot disease of pear due to *Mycosphaerella sentina* is increasing greatly, and on certain varieties causes a premature leaf fall. *Fusarium putrefaciens* was found causing a core rot of apples. The raspberry cane blight caused by *Didymella applanata* has steadily increased in Switzerland of recent years.

The control of downy mildew of the vine (*Plasmopara viticola*) is improving and also that of the 'rotbrenner' disease (*Pseudopeziza tracheiphila*) and scab ('grind') as these diseases become better understood. White or livid rot (*Coniothyrium diplodiella*) was only once reported, while *Botrytis cinerea* did considerable damage, not only by rotting the grapes but also by attacking the pedicels and causing them to dry up during damp weather in the autumn.

There was one interesting case of a bacterial disease of tomatoes which almost destroyed a considerable area under this crop in the

canton of Ticino. The affected plants were wilted, and on examination the tissues bordering on the medulla were found to be disorganized. On sectioning the diseased stems, drops filled with bacteria exuded. The characteristic green, transparent areas on the leaves ('oil spots') were also swarming with bacteria. The infection of the stems is believed to be secondary to that of the leaves, in which case an early application of Bordeaux mixture would be beneficial. Bean and pea seedlings, lettuce, and mangolds were also attacked by unspecified bacterial diseases, and tobacco leaves by *Bacillus maculicola*.

A long list of the parasites recorded on potatoes and the principal vegetable crops is given, mostly common or well-known troubles. The roots of pea plants submitted for examination were found to be infected by *Thielavia basicola*.

Amongst the miscellaneous diseases observed were attacks of *Phytophthora omnivora* on calceolarias, asters, and gooseberries.

**Division of Botany, Department of Agriculture [Canada]. Survey of the prevalence of plant diseases in the Dominion of Canada, 1922.**—*Third Ann. Rept.*, pp. iii + 1–63 and 184–192. 1923. [Mimeographed.]

This record of the prevalence of plant diseases in Canada during 1922 is based on the reports of collaborators in the various Provinces, edited by F. L. Drayton, Plant Pathologist at Ottawa. The report on potato diseases, which is separately issued, is noticed elsewhere [see below, p. 332]. The following summary covers some of the more important points.

Stem rust (*Puccinia graminis*) caused very little damage to wheat in Alberta and Saskatchewan, the losses from the disease being the slightest recorded since 1915. In Manitoba the rust was very severe on wheat growing within a 30-yard radius of some barberry shrubs at the Agricultural College, Winnipeg. Pycnidia were observed on the barberry on 15th May, and open aecidia three days later, about a fortnight earlier than the previous year. The wheat in the adjoining plots showed rust spots on 25th June. Beyond the 30-yard radius, infection occurred only on the leaves until after 12th July. Severe infection was observed in fields entirely out of reach of the barberry infection centre, and also occurred in some other parts of the Province, while the rust was absent from some areas. In New Brunswick the disease was general but not very severe. Heavy losses were reported from Prince Edward Island. On late oats, stem rust was very severe in all the provinces. Crown rust (*Puccinia coronata*) [*P. loliii*] was very prevalent in the aecidial stage on buckthorn (*Rhamnus cathartica*) in southern Saskatchewan in the early summer and was responsible for very heavy losses in the oat crops of southern Saskatchewan, Manitoba, and Ontario. Leaf rust of wheat (*Puccinia triticina*) was less prevalent than in 1921, while leaf rust of rye (*P. dispersa*) was common but not severe.

Bunt of wheat (*Tilletia tritici* and *T. levis*) was on the whole less prevalent and severe than loose smut (*Ustilago tritici*), except in Wentworth County, Ontario, where it caused most serious financial losses. Loose smut of oats (*Ustilago avenae*) was very bad in some

parts of Ontario, and was general in New Brunswick and Prince Edward Island. Covered smut (*Ustilago laevis*) was not of much importance. Wheat scab (*Gibberella saubinetii*) was widespread in New Brunswick and Prince Edward Island. Glume spot (*Septoria nodorum*) has caused a severe reduction in the New Brunswick wheat crops since 1918, and no control measures have given promising results. Dawson's Golden Chaff is highly resistant to this disease. Crinkle joint of wheat, due to an unknown cause, and characterized by a kinking of the lower internodes of the stem, occurred in Alberta and Saskatchewan. Head blight and stem rot of wheat (*Helminthosporium sativum*) was common in Saskatchewan. Leaf spot or scald of barley (*Rhynchosporium secalis*) was reported at Edmonton, Alberta, for the first time in Canada in 1921, and again occurred in 1922. Other cereal diseases reported were of minor importance.

Powdery mildew (*Erysiphe polygoni*) was extremely widespread and severe on clover in Ontario, New Brunswick, and Prince Edward Island. Flax rust (*Melampsora lini*) caused considerable injury to the fibre qualities of plants at the Ottawa Central Experimental Farm, while wilt (*Fusarium lini*) was very prevalent in some parts of southern Saskatchewan. *Sclerotinia* wilt of sunflowers (probably *S. libertiana*) was severe and widespread in Quebec, and also caused the death of 45 per cent. of the plants grown for seed at the Central Experimental Farm, Ottawa. Rust (*Puccinia helianthi*) was very common on this crop, but did not generally do much harm.

Apple scab (*Venturia inaequalis*) was common everywhere except in British Columbia, but was well held in check by spraying. Fire blight (*Bacillus amylovorus*) of apples and pears was very serious in British Columbia and Ontario. Collar rot of apples (*Armillaria mellea*) was very severe in British Columbia, where it results in the loss of thousands of trees annually. Rust of currants (*Cronartium ribicola*) was recorded for the first time on Prince Edward Island in a plantation of black currants, where 90 per cent. of the leaves were infected. White pines [*Pinus strobus*] in the vicinity showed no signs of the disease.

Root rot of pears, due to various fungi, caused a loss amounting to $12,000 in one county of Ontario alone. Wilt and blight of canning peas, probably due in part to a species of *Fusarium*, also caused heavy losses. A rusty browning of asparagus tips, the cause of which is obscure, rendered much of the crop unmarketable in New Brunswick, Quebec, and Ontario.

Many other diseases besides those mentioned above are recorded on cereals, fodder, fruit, and vegetables, and the report terminates with a survey of the diseases of ornamental plants and of shade and forest trees.

NICHOLLS (H. M.). **Annual Report of the Government Microbiologist.**—*Agric. & Stock Dept., Tasmania, Rept. for 1920–21*, pp. 10–14, 2 pl., 1922.

In the section of the report devoted to the fungous diseases of plants it is stated that club-root of cabbage (*Plasmodiophora brassicae*), which occurs mainly on acid soils and is aggravated by

the use of acid chemical fertilizers, appears to be on the increase in Tasmania, though it can be controlled by liming the soil. A similar organism has been found attacking the roots of hops in some parts of the island. The only previous record of the latter disease is from New Zealand, where it was described under the name of *Plasmodiophora humuli*. The roots of the plants decay and are finally destroyed, the hops becoming sickly and unproductive for some time before they die. The spores are spread by the water used for irrigation in the hop-gardens. *P. humuli* strongly resembles *P. brassicae*, and would probably yield to similar measures of control.

In October 1919 potato seed of the Brownell variety was heated to a temperature of 125° F. for four hours with the object of destroying various seed-borne diseases. The potatoes were then planted in an acre of new ground and twice sprayed with Bordeaux mixture 4-4-40, the first application being given when the plants were nine inches high, and the second when they were fully developed. Only a small proportion of the resulting yield was unfit for use (2¾ out of 45 bags). The following year the potatoes from the experimental plot were planted in a paddock with untreated Brownell seed, to ascertain whether the effects of the heating would extend to a second generation. During the growing period there was a marked difference between the two lots of seed, the plants in the heated plot being recognizable a mile away by their regularity and vigour. The yield from the heated plot amounted to 5·019 tons per acre as compared with 3·585 tons per acre from the untreated controls. The adoption of the heating process as a regular feature of seed-farm routine is advocated. Estimating the average increase derived from heating at 1·5 tons of potatoes per acre, there would be an annual increase of 42,000 tons on the 1919–20 statistics. The heating process should supply an easy and inexpensive means of controlling Irish blight [*Phytophthora infestans*] which is readily destroyed by four hours' exposure to a temperature of 104° F. It may be calculated that one acre of heated seed will produce enough seed for ten acres, the average size of the crop on most Tasmanian farms.

THOMAS (P. H.). **Annual Report of the Assistant Fruit Expert.**—*Agric. & Stock Dept., Tasmania, Rept. for 1920–21*, pp. 18–19, 1922.

The results of spraying experiments on the Lord Wolsey variety of apple, which was severely attacked by powdery mildew (*Podosphaera oxyacanthae*), were very satisfactory, especially those carried out with atomic sulphur. Considerable improvement was also observed in the sections treated with iron sulphide. The application of a manurial spray consisting of caustic soda and nitrate of soda resulted in an increased yield.

WHETZEL (H. H.). **Report of the Pathologist for the period 10th June to 31st December 1921.**—*Repts. Board and Dept. of Agric. Bermuda, 1921*, pp. 30–64, 1922. [Received 1923.]

The loss from disease in Bermuda crops is stated to be probably higher than in most other countries, owing to a combination of

various factors favouring the development of pathogenic organisms. Foremost among such factors is the continuous growing season, the rainy winters being particularly favourable to nearly all the disease-producing organisms. At a conservative estimate the annual loss in Bermuda crops from diseases and pests (chiefly the former) amounts to 50 per cent. In this report notes are given on the diseases and pests observed by the writer, during the time he spent in the island, to affect the more important crops, the latter being arranged in alphabetical order.

In avocado pears continuous defoliation caused by a species of *Oidium* resulted in an almost complete absence of fruit. Beans were attacked by anthracnose (*Colletotrichum lindemuthianum*), blight (*Bacterium phaseoli*), *Sclerotinia* rot (*S. libertiana*), powdery mildew (*Erysiphe polygoni*), and mosaic. Black rot (*Bacterium campestre*), frequently followed by soft rot (*Bacillus carotovorus*), occurred on cabbage, turnips, kohlrabi, kale, and other cruciferous plants. *Sclerotinia* rot was very destructive to cabbage. Celery was severely attacked by leaf blight (*Septoria petroselini* var. *apii*), black heart (believed to be due to an excessive use of fertilizers containing soda and kainit), and damping off (*Pythium* sp. ?). In lettuce heavy losses were caused by drop (*Sclerotinia libertiana*), which also attacked endive. A peculiar lettuce disease known as 'stunt', which has recently also attracted attention in the northern United States, was observed. The affected plants are stunted and produce only a few long, weak leaves, with a reddish or white discoloration according to the variety. The disease is caused by a species of *Pythium*, and can probably be controlled by disinfecting the soil of seed-beds. In Bermuda infection appears to occur in the seedlings before transplanting.

Lilies suffered severely from stump rot, due to a species of *Phytophthora*, which attacks the bulbs just as the shoots are beginning to come through the soil, or shortly after. The entire stalk may be destroyed, or only the growing tip may be killed, leaving a stump with a rosette of leaves. The fungus inhabits the soil, and spores produced on the surface are splashed by rain into the crowns of the plants. Spraying with Bordeaux mixture, dusting with copper-lime, or disinfecting the soil with formalin are recommended.

Pink root (*Fusarium malli*) is at present the only important disease of the Bermuda onion crop, though *Peronospora schleideni* is said to have caused considerable damage from time to time. In the papaw [*Carica papaya*] the yellow leaf disease (*Pucciniopsis caricae*) has been found to affect the development and ripening of the fruit and to cause premature defoliation. Powdery mildew, due to one of the Erysiphaceae, causes severe damage to papaw seedlings. It may be controlled by the application of a sulphur dust. The few peach trees left in the Colony are very susceptible to the rust *Tranzschelia punctata* [*Puccinia pruni-spinosae*], which causes continuous defoliation and prevents the setting of the fruit.

Potatoes are attacked by early and late blight (*Alternaria solani* and *Phytophthora infestans*), leaf roll, mosaic, scab caused by *Actinomyces chromogenus* [*A. scabies*], *Fusarium* stem end rot, and wilt (*F. oxysporum*). The writer states that the excellent

system of seed potato field inspection and the complete control of imports of seed tubers maintained by the Bermuda Board of Agriculture probably gives the growers the best grade of seed potatoes, as far as disease is concerned, of any similar group of potato growers in the world.

Leaf blight (*Septoria lycopersici*) of tomatoes, which greatly reduces the size and numbers of the fruit, may be controlled by the frequent application of Bordeaux mixture with the addition of fish-oil soap (3 lb. per 50 gallons).

Notes on numerous other diseases observed by the writer are given.

WATERHOUSE (W. L.). **On the production in Australia of the aecidial stage of Puccinia graminis Pers.**—*Journ. & Proc. R. Soc. New South Wales*, lv, pp. 278–288, 1 pl., 1921 [1922].

The author gives a brief description of a set of experiments carried out in 1921 at the Sydney University, in which he succeeded in inoculating two plants of *Berberis vulgaris* with sporidia of *Puccinia graminis* obtained from Wales. Inoculation of the same two plants under similar conditions with viable teleutospores from Glen Innes, New South Wales, also gave positive results. Previous attempts to infect barberry in Australia appear to have failed, though McAlpine used germinating teleutospores. In both the author's cases, spermogonia and aecidia were produced, and aecidiospores from the latter, inoculated on wheat, produced typical uredosori. No marked difference was noticed in the aecidial stage produced by the Australian and British material. These results, although obtained in highly artificial conditions, show that *Puccinia graminis* on wheat in Australia has not lost its power of producing the aecidial stage on the barberry, as believed by various workers, and the author concludes that the cultivation of barberry should be discontinued in Australia, where no native species are known, though several introduced species are grown as ornamental shrubs.

HOWARD (A.), HOWARD (GABRIELLE L. C.), & RHAMAN KHAN (A.). **The Wheats of Bihar and Orissa.**—*Memoirs Dept. Agric. India*, Bot. Ser., xii, 1, 20 pp., 1922.

In this paper, dealing with 122 of the unit species (agricultural types) of wheat isolated by the authors since 1909 from the province of Bihar and Orissa, India, is included an account of their behaviour in regard to the three rusts which attack wheat at Pusa. These are, in the order of their appearance, brown rust (*Puccinia triticina*), yellow rust (*P. glumarum*), and black rust (*P. graminis*). All the types belong to common wheat (*Triticum vulgare*), and they can be grouped in twelve botanical varieties. In the same botanical variety, agricultural types occur which differ more in their degree of susceptibility to rust than in any other character. In several instances, two types almost identical in field characters exhibited great differences in resistance to brown rust. Some of the types, particularly those belonging to the new variety *nigricans*, are very resistant to all the three species of rust.

The bulk of the paper is a description of the characters of each of the 122 types, in which the authors have adopted Eriksson's numerical notation for the degree of rust resistance.

SALMON (E. S.) & WORMALD (H.). **A safe method of preventing 'bunt' in Wheat.**—*Journ. Min. Agric.*, xxix, 8, pp. 722–728, 1922.

The authors, after calling attention to the prevalence of bunt in certain parts of England, give examples showing that the traditional method of treatment by steeping the seed grain in copper sulphate (10 per cent. is frequently used) may cause a reduction of 30 to 40 per cent. in the germination of the seed. The strongest solution (2·5 per cent.) that their experiments showed could be used without injury to germination does not satisfactorily control bunt, over 5 per cent. of the crop being bunted in some trials. They, therefore recommend that the copper sulphate treatment be abandoned.

The use of dilute solutions of formalin is strongly recommended. Tests with many strengths showed that 1 part formalin to 480 parts water (1 pint formalin to 60 galls. water) gives as good control as the 1 in 320 (1 pint to 40 galls.) usually recommended. At greater dilution than 1 in 480, formalin is less efficacious.

There is no injury to germination if the solution of 1 to 480 is used by sprinkling it over the seed wheat at the rate of one gallon to two bushels of seed, so that every grain is wetted but pools are not allowed to form under the heap of grain. The treated seed should be covered for four hours, not more, with sacks soaked in the formalin solution, and then spread out to dry in a thin layer on a dry clean floor, previously disinfected with formalin if it has been used for untreated wheat. The dried seed should be put in thoroughly disinfected sacks and sown as soon as possible.

HOPKINS (E. F.). **Wheat scab.**—*Missouri Agric. Exper. Stat. Bull.* 197, p. 48, 1922.

In this Bulletin, which is the report of the Director for the year ending 30th June 1922, is included a note by E. F. Hopkins giving the results of further experiments on the effect of hydrogen-ion concentration on the wheat scab organism (*Gibberella saubinetii*) [see this *Review*, i, p. 340]. These showed that the greater the hydrogen-ion concentration the greater the number of conidia produced on potato agar plates. Seven of the fifty-one varieties of wheat tested for resistance to scab during the year were altogether free from the disease and five others showed only a trace of infection.

KULKARNI (G. S.). **The smut of Nachani or Ragi (Eleusine coracana Gaertn.).**—*Ann. of Appl. Biol.*, ix, 3 and 4, pp. 184–186, 2 figs., 1922.

In 1918 the writer observed a smut of Nachani (*Eleusine coracana*) in the Bombay Presidency, India. The smut sori develop only in some of the grains in the head, either singly or grouped in patches of varying size. They are round or occasionally elongated, and occur in the ovary, projecting beyond the glumes, and often exceeding the diameter of the normal grains by one to six times, being 3 to 8 mm. in diameter when round, and 4 to 15 mm. in length when elongated. When fresh they are green (or occasionally pinkish) in colour, but on drying they turn chocolate-brown or dirty black. On rupturing the membrane, to which the light colour

is due, a deep brown to black, powdery spore mass is found. The dark brown spores are round, 6·6 to 12·1 $\mu$ in diameter, and with spiny walls. They germinate readily in nutrient media, forming a thick, hyaline, septate promycelium with freely budding, fusiform sporidia.

In order to determine whether the disease was seed-borne, a small quantity of Nachani grain was infected with the spores of the smut and divided into two lots, one of which was treated with 2 per cent. copper sulphate solution for ten minutes. Smut appeared on a few plants in the plot raised from infected seed, while in the treated plot all were free from the disease. The smut therefore appears to be carried by the seed and to be amenable to treatment with copper sulphate.

No smut of this host having previously been recorded, the name *Ustilago eleusinis* is proposed for the fungus, English and Latin diagnoses being given.

Burger (O. F.) & Gomme (W.). **Black rot of Oranges.**—*Florida Agric. Exper. Stat. Press Bull.* 343, 2 pp., 1922.

Black rot of oranges (*Alternaria citri*) begins at the blossom end of the fruit, and causes premature ripening. Underneath the small brown spot on the rind at the blossom end, the tissues show a brown, later greenish to black discoloration, which may extend right through the fruit to the core. In advanced cases the spot at the blossom end expands and turns dark green or black, by which time the interior of the fruit is black and the cells beginning to break down. This condition exists in the field (where it often escapes detection), and also develops in transit.

The disease was first observed in 1902 on California navel oranges, and during 1922 it was reported to occur on the varieties Ruby Blood, Parson Brown, Pineapple, Jaffa, Tangerine, and Valencia. The writers found from 5 to 25 per cent. of infection in groves inspected in November 1922.

Infected fruit should be buried and late varieties, such as Valencia, should be sprayed with 3–3–50 Bordeaux mixture with oil, a coating of which at the blossom end acts as a preventive. The crops should be shipped as soon as they are ripe.

Samuel (G.). **On the control of the brown rot disease of Oranges.**—*Journ. Dept. Agric. S. Australia*, xxvi, 4, pp. 322–324, 1 fig., 1922.

During 1922 the brown rot disease [*Pythiacystis citrophthora*] caused considerable damage to oranges in the low-lying river districts of South Australia. The severity of the disease was probably largely due to the excessively heavy rainfall, and the resulting epidemic has probably served to spread the disease to places where it was unknown before.

Affected oranges, which usually drop prematurely, have a dull brownish, rotten patch on one side, which gradually spreads until the whole orange is a shrunken brown mass, with a characteristic sickly sweet odour. The skin remains comparatively firm. Oranges near the ground are more susceptible than those growing higher up. In storage, even the most minute patches gradually

cause complete rotting, which may spread from the diseased oranges to those in contact with them.

The disease may be controlled by removing and burning or burying (with lime) all fallen oranges. The latter should not be thrown into the rivers, as the organism can live in water. The lower limbs of the trees should be pruned so that no foliage or fruit touches the ground, and the surface of the soil should be frequently cultivated during the spring and summer, especially under the trees. Irrigation can best be effected by means of trenches, which must afterwards be filled up in order to keep the surface of the soil dry. Spraying with Bordeaux mixture is a troublesome and expensive process, which should not be necessary if the above measures are carried out. It is absolutely essential that the soil be kept dry.

All oranges showing the slightest sign of brown rot should be discarded at picking time if possible, or in any case before packing. If the oranges require washing, copper sulphate (1 oz. in 60 galls.) should be added to the water.

CAMPANILE (GIULIA). **Ulteriori osservazioni sulla malattia delle frutta di Mandarino dovuta a Cytosporina citriperda Camp.** [Further notes on the disease of Mandarin Oranges due to *Cytosporina citriperda* Camp.]—*Le Staz. Sperim. Agrarie Ital.*, lv, 10–12, pp. 497–502, 2 figs., 1922.

This disease of mandarin oranges, first described by the author [see this *Review*, i, p. 426], has since been observed by Montemartini on material from Catania. According to this worker, the mycelium of *Cytosporina citriperda* penetrates the epicarp without leaving much trace, and reaches its full development only in the endocarp and in the membrane of the segments, where alone it finds favourable conditions. The depression and alteration of the overlying rind is regarded by him as a secondary phenomenon. The present author has found, however, that during certain stages of the disease a well-marked spot is formed without any corresponding growth of an internal stroma, while the mesocarp underneath the diseased area is invaded by the mycelium, which sends hyphae into the glandular cavities. This can, she thinks, only be interpreted as indicating that the alteration in the rind is not a secondary phenomenon in such cases, which, as already stated, include the first-formed spot. The later spots may be produced by an outward growth of the mycelium in the interior of the fruit. The first spot, in many cases the only external sign of the disease, is believed to represent the point of entry of the fungus.

Inoculation experiments showed that the disease can be caused by placing a small piece of stroma with pycnidia on the unwounded surface of fruit kept in a damp chamber. After fifteen days a red spot of about 4 mm. diameter became visible underneath the inoculum, and this rapidly increased to a size of 1 by 1½ cm. On the spots the characteristic stroma developed and pycnidia were subsequently formed on the epicarp. In a variant of this experiment, where the moisture was provided by adding a drop of water to the inoculum daily, the first spot to appear was a little below the point of inoculation, but a normal spot afterwards developed

underneath the inoculum. The former was evidently caused by spores washed down from the pycnidia.

A description of the cultural characters of the fungus is given. On mandarin juice agar development is very rapid and pycnidium formation starts after forty-eight hours. The pycnidia may be found full of spores before their walls are completely formed. In Petri dish cultures small, hemispherical pustules of a diameter of 2 mm. are formed after five days. They consist of masses of hyphae, and contain numerous pycnidia provided with well-developed black walls. The hyphae, olive-coloured at this stage, are generally swollen in the vicinity of the septa, and anastomoses are very frequent. During their growth the colonies become surrounded with a grey-green halo consisting of aerial hyphae possessing thin, whip-like, hyaline tips. After the formation of pycnidia the hyphae unite in massive cordons, which gradually increase in thickness and give the stroma its almost cartilaginous consistency. The usual mode of fructification is by means of pycnidia, but in certain circumstances endogenous, oval, slightly fuscous conidia, measuring 3·5 by 2·3 $\mu$ are formed, especially in the aerial hyphae. The germination of these has not been observed. Perithecia were not found. In material nearly a year old, some of the mandarin oranges had been transformed into a pseudosclerotial mass, while in others stromata were found only on the surface of the pulp, and the rest of the fruit was literally filled with a white, cottony mycelium which had taken the place of the dried pulp.

**Bud-rot in Taveuni.**—*Agric. Circ.* [Dept. of Agric., Fiji], iv, 4, p. 57, 1922.

In connexion with the coco-nut bud rot regulations [see this *Review*, i, p. 365], a tour of inspection of the coco-nut estates in Taveuni was made by Mr. M. A. Forsyth in June 1922.

In his report he stated that bud rot of coco-nuts had appeared throughout the island with more or less severity, most of the cases being found among comparatively young trees growing at some distance from the sea. Active measures are in progress to exterminate the disease, the danger of which is fully recognized by most of the European planters. Very little has been done, however, on the native-owned estates. Otherwise the health of the coco-nuts on the whole is described as very satisfactory, particularly as regards freedom from insect pests.

Speare (A. T.). **Natural control of the Citrus mealybug in Florida.**—*U.S. Dept. of Agric. Bull.* 1117, 18 pp., 1 pl., 2 figs., 1922.

The chief factor in the natural control of the citrus mealy bug (*Pseudococcus citri*) in Florida is stated to be unquestionably the fungus *Entomophthora fumosa* n. sp., first observed in 1920 at Orlando. It appears to be closely related to *Empusa lecanii*, which has been observed on *Coccus viridis*, a coffee pest in Java, but differs in the possession of resting spores and in the characters of the conidia. In some respects it also resembles *Emp. fresenii* and *Emp. lageniformis*, both aphid parasites. *Ent. fumosa* is regarded as

being as effective a control agent as the brown-tail moth fungus *Emp. aulicae.*

The description of the fungus is as follows:—Conidia more or less fusiform, 16 to 28 by 8 to 10 $\mu$, smoke-coloured, tapering rather abruptly towards the base and apex, occasionally elliptical. Apex sharply rounded, base or papilla weak but visible; conidiophores simple, smoke-coloured, slender, arising directly from spherical, yellowish, hyphal bodies. Secondary conidia elliptical, small, 4 by 8 $\mu$, rather thick-walled, without papillae, arising on 1 to 5 slender, capillary-like conidiophores from each primary conidium. Resting spores (? zygospores) apparently arising from conjugation of hyphal bodies, spherical, opaquely black, 15 $\mu$ in diameter, provided with a hyaline protuberance or appendage. When crushed the black exospore cracks, revealing the internal, hyaline, spherical, thick-walled spore. Host attached to substratum by insertion of proboscis.

On *Pseudococcus citri* on *Citrus* spp., Florida; on *P. citri* on *Ficus* sp., Louisiana; on *Phenacoccus* sp. on *Hibiscus* sp., Louisiana.

The disease can be recognized at an early stage by the milky white liquid which emerges from the bodies of crushed insects. The so-called 'hyphal bodies' present in the liquid are spherical, thin-walled, and filled with a finely granular protoplasmic content. These bodies represent a vegetative stage of the fungus, and absorb their nourishment primarily from the blood, additional food, however, being furnished by the disintegration of other tissues. Their reproduction is effected by a budding-off process. At first the insect's blood-circulation is slightly impeded and at a later stage entirely inhibited. Finally the muscles and all other soft tissues are destroyed and the interior of the body solidly filled by the fungus.

The development of the conidia and resting spores, which are formed after the death of the insect, is described in detail, the former being the more common type of reproduction in Florida. Germination of the resting spores has not been observed.

The results of investigations carried out in 1921 at Winter Haven, where weekly collections of infested mealy bugs from grapefruit were made between 13th June and 8th August, showed that on the first date only 11 per cent. were destroyed, while in the last collection 94 per cent. succumbed. There was a marked rise in the percentage of mortality between 22nd and 29th June (18 to 64 per cent.).

The artificial control of citrus diseases in Florida by fungicides and the natural control of injurious citrus insects by entomogenous fungi are antagonistic. The results of experiments have shown that, with the possible exception of lime-sulphur, all the fungicides used (Bordeaux mixture, copper soap, barium tetrasulphide, &c.) prevented the development of *Ent. fumosa* and thus facilitated an unrestrained development of the mealy bug.

VOUKASSOVITCH (P.). **Observations sur la Cochylis et l'Eudémis faites à Monlon pendant l'hiver 1921-1922.** [Observations on *Cochylis* and *Eudemis* made at Monlon during the winter 1921-1922.]—*Rev. zool. agric. et app.* (*Bordeaux*), xi, 4 and 5,

pp. 61–66 and 74–78, 2 figs., 1922. [Abs. in *Rev. Appl. Entom.*, x, Ser. A, 12, p. 620, 1922].

During the observations made near Toulouse in the winter of 1921–1922, about 70 per cent. of the pupae of the vine moths [*Clysia ambiguella* and *Polychrosis botrana*] were found to be destroyed by the fungus *Spicaria farinosa* var. *verticilloides*, the dry weather probably weakening the resistance of the insects. The fungus was readily cultivated on glycerined potatoes in Roux tubes and in nutritive G.S.P. medium (1 per cent. peptone, 5 per cent. saccharose, 3 per cent. glucose, and 2 per cent. agar). At 22° to 24° [C.] the mycelium develops very rapidly, the first fructifications appearing after 72 hours. At lower temperatures development is slower and more irregular, and in such cases potatoes are a better medium.

REDDY (C. S.) & BRENTZEL (W. E.). **Investigations of heat canker of Flax.**—*U.S. Dept. of Agric. Bull.* 1120, 18 pp., 5 pl., 4 figs., 1922.

The present paper is a report on the results of an investigation started in 1916 by the United States Department of Agriculture, in co-operation with the North Dakota Agricultural Experiment Station, of a very destructive non-parasitic type of canker of flax in the semi-arid regions of western North Dakota and eastern Montana. Of the other known types of flax cankers, anthracnose canker caused by *Colletotrichum lini* Bolley [which the authors consider to be the same as *C. linicolum*, the new name given by Pethybridge and Lafferty because of the inadequate description of the former fungus] was found, during a survey held in 1920, to be widespread in the Michigan flax-growing districts; in a number of cases flax beyond the seedling stage was attacked, and in some instances as many as 60 per cent. of the plants showed girdling connected with anthracnose lesions. The indications are that this condition resulted from a combination of injuries caused by heat and parasitic fungi, and that the area affected is determined more by temperature with its resulting physiological effects on the cells than by moisture, oxygen, or light relations. Anthracnose canker seems to be rather rare in the United States during some years, and, when present, the damage caused by it is confined almost entirely to young seedlings.

The heat canker dealt with in this paper is non-parasitic in origin. It causes severe losses and occurs to about the same extent each year in the northern Great Plains area, in the latter half of June and the first half of July. The chief symptom is the destruction of the cortical tissues at or near the surface of the ground. Plants under three inches in height are usually rapidly killed; if the injury occurs later, when the plants are three to five inches high, the latter fall over but generally continue to live for some time, as their inner vascular system is not injured. Only in rare instances are plants over five inches in height injured in this way; numerous more mature specimens of heat-cankered flax can be found, but in such cases growth continues after the initial injury. Enlargement of the stem on the older plants occurs just above (sometimes also below) the point of injury, at which point most of

the cankered stems are sooner or later severed either by the wind or by the action of saprophytes. Otherwise the plant dies when the starving roots can no longer support the needs of the aerial parts.

The evidence gathered from a number of field observations pointed to the possibility of the trouble being caused by excessive heat at soil level during the seedling stage. Field experiments, details of which are given, were therefore carried out in the period 1917–1921 in North Dakota, the results of which may be summarized as follows:—Heat canker developed mainly during or immediately following very hot, sunny days, the temperature on the surface of the soil reaching on some days 48° to 50° C. The young seedlings under four inches in height are the most susceptible, and susceptibility lessens with increasing maturity. Flax plants which have developed under hot, dry conditions are less susceptible than more succulent plants. Seedlings growing in a soil having a shallow surface mulch over a firm seed bed are less liable to be cankered than those in a soil with the surface compacted by rain, as the crust thus formed brings the overheated surface soil in immediate contact with the tender tissues of the succulent young flax stems. The incidence of canker was greatly reduced in plots where partial shading was secured either by sowing a thicker stand of flax or by cereal nurse crops or weeds growing among the seedlings, while no canker at all occurred in plants shaded by vertical strips of canvas ten inches high. A condition very similar to heat canker was artificially produced by chemical agents, such as concentrated sulphuric acid, and by heated wires looped around individual plants. Mention is also made of similar heat injuries to other plants observed and described by various authors.

Promising control measures are thicker and earlier sowing, while it is suggested that drilling the rows north and south instead of east and west may prove helpful in lessening the severity of this type of injury.

Jochems (S. C.) & Maas (J. G. J. A.). **Slijmziekte in de Hibiscus cannabinus op Sumatra's Oostkust.** [Slime disease of *Hibiscus cannabinus* on the east coast of Sumatra.]—*Teysmannia*, xxxii, 12, pp. 542–546, 1 fig., 1 diag., 1922.

Cases of slime disease (*Bacillus solanacearum*) having been reported from the newly established plantations of *Hibiscus cannabinus* on the east coast of Sumatra, a series of investigations on this disease was instituted in August 1922 at the Deli Experiment Station. The *Hibiscus* seedlings were planted on heavily infested soil, formerly occupied by tobacco and other susceptible plants such as *Phaseolus radiatus*, *Ipomoea batatas*, *Crotalaria striata*, and *Impatiens balsamina*. Three rows of healthy *Hibiscus* alternated with one row of healthy tobacco seedlings, the spacing of the plants being closer in the case of the former. Ten days after planting the *Hisbiscus* began to show signs of wilting, and at the end of twenty-five days 68 per cent. of the seedlings were dead. The tobacco plants were attacked by *Sclerotium rolfsii* and ? *Pythium*, as well as by *B. solanacearum*, but the *Hibiscus* did not suffer from any other disease but that caused by the latter.

According to Miss Westerdijk (*Meded. Deli Proefstat.*, x, p. 30, 1918) *H. cannabinus* is liable to be attacked by *S. rolfsii*, but this experiment indicates that it is, at any rate, highly resistant. After forty days, 84·7 per cent. of the *Hibiscus* plants were diseased as compared with 51·2 of the tobacco seedlings. Possibly the much closer planting of the *Hibiscus* may partially account for its greater susceptibility, infection spreading rapidly from the root systems of diseased plants to the adjacent healthy ones.

The first symptom of slime disease of *H. cannabinus* is the assumption of a horizontal position by the petioles, followed by drooping of the leaves. As a rule all the leaves of a plant droop at the same time. A further symptom generally noticeable the same day is the curling of the leaves along the midribs, with the concave sides uppermost. The next day the leaves are tightly furled and hang straight down; soon afterwards they are quite withered. Thus the whole course of the disease is much more rapid in *Hibiscus* than in tobacco.

Microscopic examination revealed no difference between the characters of the attack in *H. cannabinus* and those in other plants affected by slime disease. The causal organism was readily isolated and cultured on bouillon-peptone-agar, typical colonies of *B. solanacearum* being produced. *Hibiscus* and tobacco plants inoculated with two-day-old cultures from tobacco rapidly developed the symptoms of infection, and a few days later the causal organism was re-isolated. The discoloration of the stems was more noticeable in the tobacco plants on account of their greater transparency. All the inoculated plants died in from eight to fifteen days.

NISHIMURA (M.). **Studies in Plasmopara halstedii.**—*Journ. Coll. Agric. Hokkaido Imper. Univ.* (Sapporo, Japan), xi, 3, pp. 185–210, 6 pl. (1 col.), 7 figs., 1922.

In June 1918, the author observed that five sunflower (*Helianthus annuus*) plants in a plot containing about one hundred, at Columbia University in the United States, were infected by *Plasmopara halstedii*, a brief historical account of which is given in this paper. The diseased plants were stunted and showed well-marked light and dark green areas, which gradually spread from the region of the petiole all over the leaf, and were due to the spread of mycelium coming from the stem. Young leaves, when the chlorosis occurred along the main veins, usually became curled. An examination of the diseased plants at various stages of development showed that the fungus often originated in the underground portions and spread into the aerial parts. In *H. divaricatus*, on the other hand, infection takes place through the stomata and travels down the stem to the rhizome, where it apparently becomes perennial.

Seeds from infected sunflower plants gave a low percentage of germination but the seedlings did not show any signs of disease. Seeds sown in soil from diseased plots showed 70 per cent. of infection, the controls in healthy soil remaining unaffected. In another test, sunflower seedlings, planted in moist soil inoculated with the conidia of *P. halstedii*, became infected to the extent of 40 per cent., the control plants remaining healthy. Tests in which

the soil was inoculated with zoospores immediately before sowing the seeds gave negative results.

Sunflower plants were naturally infected by *P. halstedii* in the same fields in 1918, 1919, and 1920 successively. In order to ascertain how the fungus overwintered, three lots of soil were inoculated respectively with conidia collected from the leaves, with mycelium which developed in young seedlings, and with oospores collected from the tissue of the host plants. The soil in all three cases was left exposed during the winter 1919–20, and sunflower seeds were sown in it in the following spring. Infection occurred only in the soil inoculated with oospores.

In the course of infection experiments it was observed that when active zoospores were brought into contact with a sunflower root in sterilized water, the zoospores came to rest on the root in one or two hours. Some produced germ-tubes of varying lengths which entered the roots and developed in the intercellular spaces. In some cases the infection occurred where the root hairs had broken off, but entry could also take place through the quite uninjured epidermis.

The mycelium was found in the intercellular spaces of all the tissues and, in young plants, even in the vessels. Diseased plants develop fewer secondary roots. In numerous instances conidia developed in the intercellular spaces of the spongy tissues, and in the substomatal cavities of the leaves; also in the root and stem tissues, especially following injury by insects or other agencies. In fresh material the oogonia and antheridia are found scattered through the root tissue. The former are large, globose bodies, 30 to 48 $\mu$ in diameter, the latter somewhat irregular in shape and 12 to 30 $\mu$ in diameter. Some of the short branches of the mycelium swell at the end and become filled with a dense mass of protoplasm. Oospores may also develop in the leaves and stem. Sunflower seedlings infected with *P. halstedii* late in April showed a number of oospores four to six weeks later, while in July and August the sexual stage is less common. The oospores are generally formed most readily when the vitality of the host has declined. The mature spores were often found just beneath the epidermis, the inner wall of which was ruptured by them.

The second part of the paper deals with a cytological investigation of the methods of fertilization and oospore formation.

WATERS (R.). **Apple flesh-collapse or brown-heart. Some recent investigational work.**—*New Zealand Journ. of Agric.*, xxv, 6. pp. 334–340, 1922.

Flesh-collapse, now known to be identical with the 'brown-heart' of apples shipped from Australia and Tasmania [see this *Review*, ii, p. 124], has been found to be much more prevalent among mature fruit and may be largely avoided by selecting greener apples for storage. This is, however, by no means the only factor to be considered, since in cases observed by the author 12 per cent. of even the least mature fruit were affected after five months' cool storage.

In 1922 flesh-collapse was first noted about the end of June, rather less than three months after the fruit was placed in cool

storage, while in the two preceding years it was not observed until September. The experience of certain growers indicates that fruit held without cooling up to seven weeks after picking has subsequently stood cool storage conditions better than that stored immediately after gathering. The most difficult time to secure control of cool storage conditions is during the first few weeks, when some, at any rate, of the damage to the 1922 consignments occurred.

Natural conditions of temperature and humidity in the Nelson district admit of keeping Sturmer apples in suitable sheds until August or September, after which time the fruit becomes liable to shrivel on account of the lower relative humidity (averaging 82), while in the cool stores the humidity is more often near the saturation point. To be of practical value, cool storage during the period until August or September should more completely arrest the activities of the fruit than can be done in a shed: otherwise shed storage during this period would be just as good. The first essential in accomplishing this is a lower atmospheric temperature range, for the lower the temperature range in the apple-flesh (within limits) the slower is the progress of the metabolic processes in the fruit. It has been shown by statistics that the apple is extremely tolerant of fluctuating temperatures, which are averaged out by the fact that the flesh of the fruit heats and cools more slowly than the surrounding atmosphere. Thus the average of the mean monthly temperatures from May to September (47·8° F. at Nelson in 1920) will correspond closely with that of the apple-flesh temperature in the sheds. At this temperature the apples ripen more rapidly than would permit of long storage and the mean apple-flesh temperature in cool stores must therefore be kept considerably below 47·8° if it is desired to secure successful storage for seven or more months. The relative humidity must be over 82 in order to prevent shrivelling, and a minimum temperature of the atmosphere discharge from the cooling plant of 32° F., the plant being run for twelve hours, is well on the safe side.

Discussing the technical details of cool storage, the author points out that the only way to surmount the various difficulties that may arise in bringing down the temperature of the stored mass of fruit cases sufficiently quickly, removing the excess moisture, securing adequate ventilation, and the like, is to increase the rate of circulation of the air. The greater cooling and drying efficiency of the plant thus secured will reduce the necessary hours of running and leave an interval during which defrosting and ventilation can be safely performed. These measures are particularly necessary in the early part of the season, when flesh-collapse appears to be initiated.

The maintenance of very even temperatures, which is the usual policy in cool stores, appears in some cases to have led to increased humidity and a decreased efficiency of ventilation. In considering this question, attention must be paid to the temperature at three separate positions—in the flesh of the apples, in the atmosphere within the cases, and in the atmosphere of the storage chamber. The longer the working hours the nearer will these three temperatures be to one another, and the slower will be the diffusion between

the atmosphere of the case and that of the chamber. A reduction in the number of working hours would result in greater differences between the temperature of the case-atmosphere and the chamber-atmosphere: hence there would be a quicker passage of the gaseous and vaporous apple by-products out into the chamber-atmosphere, where they become dispersed and are later disposed of by ventilation.

WILTSHIRE (S. P.). **Studies on the Apple canker fungus. II. Canker infection of Apple trees through scab wounds.**—*Ann. Appl. Biol.*, ix, 3 and 4, pp. 275-281, 1 pl., 1922.

Infection of the shoots by *Venturia inaequalis* occurs during the autumn and winter following their growth. In the spring most of these scab pustules are surrounded by a cork layer, and are subsequently completely cast off from the tree, leaving only a slight roughness of the bark.

This course of events, however, is sometimes disturbed by the invasion of the scab pustules by the canker fungus (*Nectria galligena* Bres.), which develops so rapidly that an area about 5 mm. in diameter is destroyed before phellogen formation can take place. In the early stages the canker area is usually somewhat sunken, there is no crack in the bark between healthy and diseased tissue, and the scab infection can often be identified in the centre of the scar. Subsequent phases of development are often characterized by the formation of well-defined cracks at the edge of the infected area and a slight swelling of the adjacent tissues. Unless the tree is sufficiently vigorous to form a cork layer round such a scar before the wood becomes infected, the fungus penetrates to the deeper tissues, in which case the scar resembles a normal canker produced by *N. galligena*. The occurrence of this type of infection, though less common than that of the leaf scar type previously described [see this *Review*, i, p. 106], is probably as prevalent as infection through woolly aphis galls.

Early in the autumn, when the scab pustules are still very small, microscopic examination frequently reveals the presence of *N. galligena* established on the stroma of the scab fungus, where it develops its characteristic conidial stage. It is somewhat difficult to distinguish between the mycelia of the two fungi, but, generally speaking, that of *Venturia inaequalis* appears dark and thick-walled, while that of *N. galligena* is hyaline and less robust.

As soon as the canker fungus has gained a firm hold on a scab pustule, the struggle with the tree then begins. The cork layer referred to above is often a sufficient barrier, since the canker fungus is not normally capable of penetrating cork, but it may not be developed quickly enough to confine *N. galligena* to the outside of the barrier. Furthermore, *V. inaequalis* is normally able to penetrate suberized tissue, especially at the edges of an infected region, and when this occurs the *Nectria* appears to follow the scab fungus, and subsequently outgrows the latter. In such cases, the *Nectria* hyphae grow inwards between the cells of the cortical tissue, gradually forming strands of mycelium, which are frequently found radiating from an infected scab pustule, and which are very characteristic of this type of infection. *N. galligena* also appears

to secrete some enzymic substance, which is able to attack the cell walls of the cortical tissue in advance of its growth, the walls being partially disorganized. This substance may be a potent factor in overcoming the resistance of the host, for though previous experiments indicated that the enzymes cannot pass through a well-developed cork layer, such as is formed in the summer on growing trees, infection through superficial wounds in the winter months and on cut shoots, where cork formation may be imperfect, sometimes leads to penetration of the cortex.

Once the canker fungus has effected an entrance to the cortex it develops rapidly in all directions, especially along the intercellular spaces. The cells of the cortex in the neighbourhood divide rapidly, and the intercellular spaces become more or less obliterated. This new tissue soon becomes infected unless protected by a cork layer. The host persists in its efforts to form a wound cork layer, especially in the region between the sclerenchymatous bundles of the cortex, the growth stimulus sometimes being so strong that the tissues become ruptured. A strong cork layer is ultimately formed round the infected tissue, and later the concentric cracks in the canker scar which are typical of the disease develop. The stem sometimes becomes completely girdled, the whole of the shoot above being killed.

The usual practice of spraying against scab in the spring does not provide for the control of autumn infection as described above. Possibly winter spraying immediately after defoliation might prove effective.

CUNNINGHAM (G. H.). **Coral-spot, Nectria cinnabarina (Tode) Fries. A wound parasite of fruit-trees.**—*New Zealand Journ. of Agric.*, xxv, 6, pp. 354–359, 7 figs., 1922.

Coral spot (*Nectria cinnabarina*), the symptoms and life history of which are described and figured, caused considerable losses in Central Otago in 1919, when hundreds of fruit trees, especially apricots, were killed outright. In ordinary cases the effects of the fungus in any one orchard are generally slight, but it may cause quite a large reduction in output by destroying the fruiting branches, especially where the trees have previously been injured by frost or insects.

The following preventive measures are recommended: removal of dead wood from the trees, burning of all prunings and other rubbish, and trimming of all rough edges of wounds. Split branches should be bound up or excised, and deep, narrow crevices filled with grafting-wax or other suitable matrix. Gum-pockets should be cut out, and all exposed surfaces coated with coal-tar. All wounds should be painted annually until they are closed by callus.

LINE (J.). **The parasitism of Nectria cinnabarina (coral spot) with special reference to its action on Red Currant.**—*Trans. Brit. Mycol. Soc.*, viii, 1–2, pp. 22–28, 1 pl., 1922.

After a short reference to the previous work on *Nectria cinnabarina*, the 'coral spot' fungus, well known on many broad leaved trees and also on dead branches of red and black currant bushes in

England, the author describes the field observations and experiments made by him in an endeavour to establish (*a*) to what extent the fungus may be regarded as a parasite, particularly on the red currant; (*b*) its normal way of infection and method of growth in the host tissues; and (*c*) whether any differences in power of infection could be detected between different strains of the fungus.

Both direct observations in nature and inoculation experiments indicate that *Nectria cinnabarina* cannot establish itself directly in healthy, uninjured tissues, but that it can do so occasionally when introduced into a wound in certain woody plants, more readily in the case of the lime and horse-chestnut than in the case of the red currant. Its normal method of attacking the red currant is by spread through the wood cells, from a dead portion on which it has gained a footing, into the healthy wood. Infections made on artificially killed side shoots led to the development of stromata on these shoots in six weeks or more, and then—at least six months after inoculation—the fungus worked its way into the main stem and became established as a parasite. The harmful action of the fungus is primarily due to its growth in the xylem elements, which are blocked by the fungal hyphae, thus causing death of the living cells above the infected area on account of water shortage. No ill effects appear to be shown for some time by the leaves and flowers, even when the stem bearing them is almost completely blocked by the mycelium at a lower level; then they suddenly show signs of wilting. It is therefore thought improbable that any toxic substance is secreted by the fungus which can affect living cells in advance of the hyphae.

The red currant (which is much more frequently attacked than either the black currant or the gooseberry) is usually somewhat heavily pruned, and furnishes a number of dead spurs each year. These were observed to be the starting-points of the fungus in the great majority of cases. The time of the actual invasion of the main stem does not appear to be related to the time at which the first infection took place. Older bushes suffer more severely from the fungus than the younger and more vigorous bushes of the same variety, but the indications were that in most cases, the fungus had been growing for several years on the older bushes, before death of branches occurred on a large scale. No differences in power of infection or behaviour in culture were observed between strains of the fungus isolated from different sources. Further work is being done in collecting evidence as to the resistance of different varieties of the red currant to the fungus and as to the effect of soil conditions.

CUNNINGHAM (G. H.). **Leaf-rust, Puccinia pruni-spinosae Pers. Its appearance, cause, and control.**—*New Zealand Journ. of Agric.*, xxv, 5, pp. 271–277, 9 figs., 1922.

Leaf rust of stone fruit trees is common in New Zealand on the leaves of nectarines, peaches, and plums, less so on almonds and apricots, and rare on cherries. The aecidial stage of the causal organism, *Puccinia pruni-spinosae*, occurs in New Zealand only on the cultivated anemone.

The infection, which is more severe in wet seasons, first becomes

noticeable on the leaves towards the end of December. Small yellow areas, in the centre of which are rusty-brown masses of uredospores, are formed on the under side of the leaf. Partial or total defoliation follows, and when infection persists for several seasons the trees become very susceptible to the attacks of silver blight [*Stereum purpureum*], brown rot [*Sclerotinia cinerea*], and other parasitic diseases. Small, circular, depressed spots are formed on the fruit, uredosori being visible in the reddish borders as maturity approaches. Diseased fruit is frequently so disfigured as to be unsaleable. Leaf rust forms small cankered areas on the shoots of certain peach varieties, the bark splitting longitudinally and the uredosori occupying the crevices.

The life history of *P. pruni-spinosae* is described. Teleutospores are stated to be comparatively rare in New Zealand, except on plums. In view of the limited distribution of anemones in the Dominion, the overwintering of the fungus is thought to be effected mainly by means of the uredospores.

In a note on the control of leaf rust, by J. A. Campbell, the following spraying schedule is recommended: (1) when the buds begin to swell, 5-4-50 Bordeaux or 1-15 lime-sulphur: (2) one month after petal-fall, 1-120 lime-sulphur; (3) when the fruits are half-grown, 1-120 lime-sulphur; (4) shortly before the fruits reach maturity, 1-120 lime-sulphur; (5) shortly after the fruit has been picked, 1-120 lime-sulphur. The final application may require repetition one or more times.

Deep ploughing and careful turning over of the soil to bury infected leaves are essential.

POPE (W. T.). **Avocado die-back.**—*Rept. Hawaii Agric. Exper. Stat., 1921*, p. 12, 1922.

Serious losses have been caused by die-back of avocados, which generally sets in about the time the young trees first come into bearing. The principal symptoms are the wilting, brown discoloration and final dying back of branches, yellowing of the leaves, lifeless appearance of the roots, and the frequent sudden death of trees when laden with fruit. The disease has also been reported to occur on Tahiti and other Pacific Islands.

Mild forms of die-back may be controlled to some extent by pruning out the dead parts of the top and applying plentiful quantities of thoroughly rotted farmyard manure and water to the roots. The disease is believed to be due to a variety of physiological causes, such as defective drainage, an excess of volcanic sand or a layer of rock, or an inadequate water supply. The principal losses occur during the dry summer weather.

CARLETON (M. A.). **Note on the Fusarium wilt disease of Bananas.** —*Science*, N.S., lvi, 1,458, pp. 663-664, 1922.

Referring to Gäumann's paper on a vascular disease of the banana in the Dutch East Indies [see this *Review*, i, 7, p. 223], the author states that while working with the United Fruit Company in Panama he conducted an outdoor pot inoculation experiment on the same lines as that made by Brandes with *Fusarium cubense*

(*Phytopath.*, ix, 9, p. 339, 1919), except that the Gros Michel variety was used instead of the Chamalucco.

On 1st November 1921, the soil in fourteen pots was sterilized by means of steaming for two hours at 110° C. Six pots were neither sterilized nor inoculated. All the pots were planted with one 'bit' of a banana having two 'eyes', and seven of those sterilized were inoculated with *F. cubense*. The inoculum, which was a combination of two cultures, one in cornmeal decoction and the other in Uschinsky's solution, was applied in the proportion of about 1 litre per pot. By 1st April 1922 all the inoculated plants were diseased, most of them being severe cases. Up to 12th July following, when the writer left Panama, none of the plants in the uninoculated pots, sterilized or unsterilized, gave any indication of the disease.

This experiment, which has the added interest of being carried out in a different locality from that of Brandes, confirms the latter's conclusions that the destructive wilt or Panama disease is due to *F. cubense*.

**Informazione.** [Notes.]—*Boll. mensile R. Staz. Pat. veg.*, iii, 7-9, pp. 91–110, 1922.

In the '*Coltivatore*' of 30th August 1922, Ciferri describes a bacteriosis of olive twigs encountered in rather old and not very flourishing trees in the province of Macerata. The disease is marked by the withering and drying up of some of the young branches, in which the cambium is found disorganized and turned brown, the pith being also often partially disorganized. The disease, which is quite distinct from the olive knot [caused by *Bacterium savastanoi*], agrees with one described some ten years ago by Montemartini, who named the organism to which it was due *Bacterium olivae*. According to Ciferri this is a weak parasite, incapable of penetrating unwounded tissues, or rather a saprophyte which becomes parasitic when the host is in particularly unfavourable condition as, for instance, when it suffers from root disease.

MORETTINI (A.). **Influenza dei trattamenti cuprici sulla produttività del Frumento.** [The influence of the treatment with copper compounds on the productivity of Wheat.]—*Le Staz. Sperim. Agrarie Ital.*, lv, 7-9, pp. 264–277, 1922.

The author's experiments, which are described in detail, indicate that the treatment of seed grain of wheat with dry copper carbonate or dry Caffaro powder results in an increased yield even when no bunt [*Tilletia tritici*] is present. In his tests bunt-free seed was used, and the treatments applied were respectively immersion in water for 17 minutes, immersion in 0·5 per cent. copper sulphate for 15 minutes followed by dipping in a lime bath for two minutes, dusting with dry Caffaro powder used at the rate of 3 parts of the powder to 1,000 parts of grain, and dusting with dry copper carbonate in the same proportions. A fifth lot was sown untreated as a control. All the seed was kept for 12 days before sowing. No bunt appeared and the yield at harvest showed the highest figures for the copper carbonate treatment; Caffaro powder was next, then copper sulphate, water, and control in the

order named. These results are explained by the fungicidal action of the copper compounds in preventing injury from the ordinary soil fungi or those carried in on the grain, this beneficial effect being counteracted in the case of the copper sulphate treatment by injury to the embryo of the seed. A contributory cause may be that the copper exercises a stimulatory action on the growth of the plant.

VAN DILLEN (L. R.) & GANDRUP (J.). **Een kleurmiddel voor desinfectantia bij de behandeling van streepjeskanker.** [A colouring matter for disinfectants used in the treatment of stripe canker.]—*Arch. voor Rubbercultuur*, vi, 1922. [Abs. in *Teysmannia*, XXXIII, xi, pp. 526–527, 1922.]

For several years there has been an increasing demand for an economical colouring matter for creoline, carbolineum plantarium, izal, and the other disinfectants used in prophylactic treatment for the control of stripe canker [*Phytophthora*] of *Hevea* rubber. Indigo has been used to some extent, but besides being very expensive it has the drawback of discolouring the manufactured rubber.

In the present paper fuchsine, which colours the painted surface a vivid red, is recommended. It causes no injury either to the appearance or internal qualities of the rubber, and being much more conspicuous than indigo or methylene blue, it affords an easy method of detecting the treated trees. It does not interfere in any way with the technical processes of rubber manufacture.

The writers used a Java preparation of fuchsine costing about 20 florins [about £1. 14s.] per kg. For use with izal a concentration of 0·5 per mille sufficed, while double that amount was required to produce a good colour with creoline and treble with carbolineum plantarium. The addition of fuchsine to a 5 per cent. solution of creoline or carbolineum plantarium, the cost of which is about 5 cents [100 cents = 1 florin] per litre, would involve an additional expenditure of 2 and 3 cents respectively.

RUTH (W. A.). **The effect of Bordeaux mixture upon the chlorophyll content of the primordial leaves of the common Bean, Phaseolus vulgaris L.**—*Amer. Journ. of Bot.*, ix, 10, pp. 535–550, 1922.

The fact that a number of plants show a distinctly greener colour after being sprayed with Bordeaux mixture suggests that spraying increases the chlorophyll content of the leaves. The experiments described in this paper were devised for the investigation of this phenomenon.

Bean plants were grown under very carefully controlled conditions in a greenhouse. The results were obtained from primordial leaves only, which were measured and weighed in the fresh condition and immediately dried in a rapid current of air at 45° to 50° C. The leaf areas were estimated by drawing the outline of the leaf on paper and weighing the enclosed portion. As soon as the leaves were crisp each lot was placed in a small tin box until its chlorophyll content was determined. The latter was accomplished by colorimetric comparison of acetone extracts with an

extract standardized according to a method essentially the same as that of Willstätter and Stoll (Untersuch. über Chlorophyll, Methoden und Ergebnisse, Berlin, 1913).

Before determining the effect of spraying upon the chlorophyll content, the degree of variation in the chlorophyll content which took place as the plant grew was determined. Primordial leaves at four ages were used for this purpose. During the period before the cotyledons were shed, there was a marked increase in the amount of chlorophyll per sq. cm., and an even more marked increase per gram of fresh weight. From this period onwards, there was a decrease in the amount of chlorophyll to the sq. cm. and per gram of fresh weight, which was associated with an increase in the fresh weight of the leaf per sq. cm. and a lessened rate of increase in area. The necessity was recognized of comparing plants harvested only at the same stage of development.

The correlation between rapid growth and high chlorophyll content was determined also by cutting off the growing buds above the primordial leaves in order to increase the latter's growth. A greater chlorophyll content per sq. cm. was produced by this treatment as compared with controls.

To determine the effect of Bordeaux on growth in length, one half of the seedlings in each of five flats were sprayed as soon as the primordial leaves unfolded. It was found that the relation of the sprayed leaves to the unsprayed, 0, 2, 4, 8, and 14 days after spraying, was 103, 97, 96, 96, and 95 to 100.

The effect of Bordeaux on the development of chlorophyll was investigated by spraying one-half the plants in 3 flats as soon as the primordial leaves had unfolded, and one-half the plants in 3 other flats when the cotyledons were dropping, 4 days later. Three days after the latter spraying all the plants were harvested. The average of the areas of sprayed and unsprayed leaves per flat was 53·3 and 57·9 sq. cm. respectively and the chlorophyll content (mg. per sq. cm.) 0·00390 and 0·00361 respectively. The average chlorophyll content per leaf of the sprayed and the unsprayed leaves was practically the same.

The probable relations between photosynthesis and the increased chlorophyll content are discussed, especially with regard to published work on the subject, but experiments on this problem are reserved for further work.

A bibliography of 42 titles is appended.

PICHLER (F.) & WÖBER (A.). **Bestrahlungsversuche mit ultraviolettem Licht, Röntgenstrahlen und Radium zur Bekämpfung von Pflanzenkrankheiten.** [Radiation experiments with ultra-violet rays, X rays and radium for the control of plant diseases.]—*Centralbl. für Bakt.*, Aht. ii, lvii, 14–17, pp. 319–327, 1922.

Experiments in the control of bunt of wheat (*Tilletia tritici*), loose and covered smut of barley (*Ustilago nuda* and *U. hordei*), loose smut of oats (*U. avenae*), and maize smut (*U. zeae*), by means of exposure to ultra-violet rays and X rays proved very successful. Exposure of the dry spores to ultra-violet rays inhibited germination more completely than when the spores were placed in tap

water, while germination was entirely suppressed when the spores were exposed for 30 minutes to these rays in 0·1 per cent. hydrochloric, sulphuric, or oxalic acid, or in 0·25 per cent. $NaHSO_4$, or 0·1 per cent. $KClO_3$, or in a combination of 0·1 per cent. $H_2SO_4$ + 0·1 per cent. $KClO_3$. The last mixture gave, on the whole, the best results. Both oxygen and copper salts were activated by ultra-violet rays, and showed enhanced fungicidal efficacy in the presence of the latter. The action of solutions of colouring matters, e.g. methylene blue or iodeosin, was also intensified by ultra-violet rays. In field tests winter wheat seed severely infected by *T. tritici* was exposed to ultra-violet rays in a solution of 0·1 per cent. $KClO_3$ + 0·1 per cent. $H_2SO_4$ for 20 minutes, with the result that the incidence of infection was reduced to 20 per cent. as against 62 per cent. in the untreated controls.

Excellent results were obtained by the use of X rays, which have the advantage over ultra-violet rays of penetrating the interior of the plant, and are therefore more likely to be of use in such cases as potato wart disease (*Chrysophlyctis endobiotica*) [*Synchytrium endobioticum*]. There was a slight retardation in germination when bean and barley seed was exposed to X rays, but this disappeared later on. As with the ultra-violet rays, treatment in the acid solution $H_2SO_4 + KClO_3$ produced the best results in tests made on bunt of wheat, loose smut of barley, and oat smut. Exposure for one hour caused a slight reduction in germination in the case of oats, but eliminated all the smuts, even that of barley which is ordinarily only controllable by the hot water treatment. Exposure in alkaline solutions was not nearly so successful.

Similar experiments with radium gave negative results.

Jewson (Sibyl T.) & Tattersfield (F.). **The infestation of fungus cultures by mites (its nature and control together with some remarks on the toxic properties of Pyridine).**—*Ann. of Appl. Biol.*, ix, 3 and 4, pp. 213–240, 3 figs., 1922.

The infestation of fungus cultures by mites, especially by *Aleurobius farinae* and *Tyroglyphus longior*, is a source of considerable annoyance in mycological laboratories. The authors' experiments showed that the mites can be controlled by exposing the cultures to the vapours of pyridine, an exact description of the method employed being given. In laboratory apparatus the pests can be eliminated by the application of strong ammonia. Pyridine is shown to have a slight toxic action on fungi, but in ordinary practice this may be disregarded.

**Informazione.** [Notes.]—*Boll. mensile R. Staz. Pat. veg.*, iii, 10–12, pp. 125–150, 1922.

Notices of the following papers of interest are contained in this number of the *Bollettino*.

Manzoni has published in the *Coltivatore* additional notes on the leaf curl ('incappucciamento') of *Trifolium pratense* [see this *Review* i, p. 419], in which he states that the bacterium isolated by him is evidently allied to one found in similar conditions by Baccarini and Bargagli-Petrucci in 1914 and described by them in the *Atti della R. Accad. dei Georgofili*. The differences between the

two organisms are probably to be traced to the use of different culture media.

Vaglio in the *Italia vinicola ed agraria* discusses the respective merits of dry and wet fungicides for vines. In the author's comparative tests, sprayings with copper solutions have given the best results as regards both *Peronospora* [*Plasmopara viticola*] control and vegetative growth. The fungicidal dusts protected the grape clusters well, but did not act as satisfactorily on the leaves. Sprays are, therefore, recommended, wherever water is available, supplemented by sulphur and copper sulphate dustings for the better protection of the fruit clusters.

The Stazione Chimico-agraria, of Udine, gives in the *Rivista di Ampelografia* an account of experiments designed to control simultaneously the downy and powdery mildews [*Plasmopara viticola* and *Uncinula necator*] of the vine by the employment of fungicidal dusts. 'Cuprosolfol' has given results in this respect which are not inferior to those obtained with sprays, but particulars as to cost are wanting.

Ravaz, in the *Progrès agricole et viticole*, No. 45, recommends the following treatment in cases of partial 'apoplexy' of the vine, [caused by *Fomes igniarius*: see this *Review*, i, p. 417] when, as is not infrequently the case, only a branch is attacked. The latter is removed, and, if possible, all affected wood is cut out, after which a layer of tar is applied, or better still, all old and recent pruning wounds are treated with an arsenical mixture. The following, devised by Gauthier, is recommended: arsenious acid 15 kg., carbonate of soda 15 kg., soap 15 kg., water 65 litres. The carbonate of soda is dissolved in the quantity of water indicated, which is first warmed, and then the arsenic powder is added to the still warm mixture which must be stirred with a wooden implement. Finally, the soap is added. The latter is not strictly necessary, and where arsenious acid is not available this can be replaced by arsenite or arsenate of sodium. The mixture has to be diluted with 10 to 12 times its volume of water before use.

RAYNER (M. C.). **Mycorrhiza in Ericaceae.**—*Trans. Brit. Mycol. Soc.*, viii, 1–2, pp. 61–66, 1922.

In the present critical review of H. Christoph's paper on the mycotrophic relations of the Ericales [see this *Review*, i, p. 129], the author deals only with the part of her work concerning seedlings of *Calluna vulgaris*, reserving the part relating to the behaviour of cuttings pending the results of further experiments. She maintains her conclusions that under the experimental conditions described in her earlier paper [*Ann. of Botany*, xxix, pp. 97–133, 1915] the development of *Calluna* seedlings is dependent on infection by the mycorrhizal fungus and that such infection takes place regularly from the testa of the seed at, or subsequent to, germination. With regard to the results obtained by Christoph, where unsterilized seeds sown on sterile peat produced, after six months, seedlings in all cases free from fungous infection, with roots as vigorous as those of infected controls, the author points out that until her claim that seed coat infection occurs has been disproved, all seedlings raised from unsterilized

seed should be assumed to be liable to infection at germination. It is not always easy to observe infection in the clean roots of seedlings, and in the absence of opportunity to examine the material it is only possible to suppose that the presence of mycelium in the roots has been overlooked by Christoph. The same criticism applies to his results obtained when sterilized seeds were sown on sterilized soil, since no proof is given that the seeds were really sterile. Similarly in the experiments in which sterilized seeds were sown on unsterilized soil, no controls were sown on sterile media and no proof of any kind is offered that the seeds were adequately sterilized. If the soil used was from a *Calluna* station, infection could obviously take place from such soil.

Further criticisms apply to Christoph's failure to maintain his cultures of sterilized seeds on sterilized soil under aseptic conditions, as shown by a quotation from his paper mentioning the presence in his cultures of mixed infection with species of *Mucor* and *Citromyces*. Neither does the author consider Christoph to have given satisfactory proof of the identity of the fungus isolated by him from *Calluna* roots with the endophyte; so far as it is possible to judge from his description of morphological characters, the right organism was isolated, but the positive proof of identity can only be supplied by inoculating into a pure culture seedling, growing under controlled conditions, and observing the subsequent production of mycorrhiza.

Another explanation of the discordant experimental results recorded by Christoph may be found in the possibility of the presence, in the sterilized peat used in his cultures, of an organic substance capable of replacing the stimulus to development of the seedling normally provided by the endophytic fungus, and this question is now being fully investigated.

PEROTTI (R.) & CORTINI-COMANDUCCI (I.). **Normale presenza di batteri nelle radici di numerose Fanerogame.** [The normal presence of bacteria in roots of numerous Phanerogams.]—*Rend. Acc. Lincei*, xxxi, ser. 5 a, 2 sem., 10, pp. 484–487, 1922.

In the roots of 75 per cent. of the normally developed phanerogamic plants examined by the authors, belonging to various non-leguminous families which have up to now been considered autotrophic, bacteria are found in such numbers that their presence cannot be regarded as accidental. These organisms are distributed throughout the cortex, and in some cases penetrate to the outer zone of the bast, where they are found in the intercellular spaces. At times their presence inside the cells has been detected.

Although it is not contended that these bacteria are necessary for the development of the plant, their presence is not only not harmful, but the state of growth of some specimens examined leads to the belief that it is of advantage to the plant.

The methods of investigation are briefly described, and a list of the plants examined is given. The organisms found in *Diplotaxis erucoides* and *Calendula officinalis* belong to several forms or strains, generally oligonitrophilous, possessing characters which might prove of value to the plants, whether green or not green, with which they live in symbiosis.

SURCOUF (J. M. R.). **Recherches sur la biologie du Phœnix dactylifera. Etude sur la culture, les maladies et les parasites du Palmier Dattier en Algérie (suite).** [Investigations into the biology of *Phoenix dactylifera*. Notes on the cultivation, the diseases and parasites of the Date Palm in Algeria (contd.).]—*Bull. Soc. Hist. Nat. Afrique du Nord*, xiii, 9, pp. 293-312, 1922.

This is an account of the cultivation of date palms in Algeria. In the section devoted to pests and diseases it is stated that 'baïoud' or 'white', a serious disease originating in Tafilalet, has caused some damage in the Figuig district [see this *Review*, i, p. 18]. Palms affected with this trouble die rapidly, and the interior tissues are found in a putrescent condition. According to investigations carried out by the Pasteur Institute at Algiers and by Maire, the disease is spread by the irrigation water.

Another rapidly fatal disease was found to affect trees at Ain-Srouna, in the Oued Rhirh. Nineteen young palms succumbed in the space of a few days; their sap was decomposed and had a strong vinous odour. Numerous saprophagous insects were found inside the palms, but none of them was responsible for the disease, which came on while the trees were in full vigour and while their roots were still actively functioning.

A disease, which affects the fruit only and is called by the natives 'n'faroun', was observed by the author at Tolga and particularly in the Oued Rhirh. It occurs towards September and is characterized by a marked browning of the dates, which become dull and are finally covered with a whitish, pollen-like substance. This modification is brought about by the drying of the epidermis, which is raised in places, and may become flaky. The dates become covered with spores and the ripening process is retarded, the fruit drying up without acquiring the sweet flavour associated with normal dates at maturity. The disease affects frequently a whole garden, or even a palm grove, but the author has only observed it on the 'Deglet Nour' variety, not on 'Ghars', which ripens earlier.

BROWN (W.). **Experiments on the growth of fungi on culture media.**—*Ann. of Botany*, xxxvii, 145, pp. 105-129, 7 figs., 1923.

This paper deals with the so-called 'staling' of fungal cultures. By 'stale culture' is understood one which has ceased, or practically ceased growing; a 'stale medium' is a medium which, through the growth in it of an organism, has been made useless, or nearly so, for further growth of the same or other organism. By 'staling substances or products' are meant those metabolic products of the organism which are responsible for slowing down or stopping its growth.

The general method of experimenting was based on observations of the rate of growth of colonies in Petri dishes, and was in general similar to that more fully described in an earlier paper [see this *Review*, ii, p. 24]. As a rule, the rate of spread of a fungal colony increases to a maximum, then remains steady or slows down. The higher the temperature, the sooner the maximum growth rate

is reached, at least in the case of some of the fungi tested. Fungi which show no appreciable decline from the maximum are described as being of the non-staling type, while those in which the rate of growth falls subsequently are described as being of the staling type. Periodical measurement of the diameter of the colony enables these variations to be followed, the results being shown in graphs. The fungi used were mainly *Sphaeropsis malorum* and a species of *Fusarium*, both of which show well-defined staling phenomena.

The amount of staling shown by a particular organism varies with the medium employed (being absent, for instance, when Richards's solution with agar was used) and is dependent upon the amount of the particular medium present. In certain cases it can be modified by slightly altering the conditions under which the experiment is carried out. Thus a greater amount of staling was shown by *S. malorum* when grown on potato agar in closed Petri dishes, than when it was grown on the same medium in open Petri dishes placed in large 5-litre containers, the difference being produced by variations in the conditions of gaseous exchange in the two cases. The same results are obtained with the *Fusarium*, but they are less marked as a rule. The reason of this behaviour was shown to be, not the influence of the oxygen contained in the atmospheric column present in the case of the open dishes, but the action of gaseous or volatile products of the metabolism of the fungus, which in this case were found to be carbon dioxide and ammonia. According to the extent to which these products accumulate or are disposed of, the amount of staling varies. When ammonia is in excess, the result is the accumulation of ammonium carbonate and free ammonia in the medium, and this is a more actively staling combination than the ammonium bicarbonate that forms when carbon dioxide is in excess.

Two main lines of experiment are described. The first consisted of exposing plates of fresh medium to the gases given off by fungal cultures, after which the exposed plates were tested for staleness by inoculating them with various fungi. The other method was to grow fungal colonies in atmospheres which were controlled in respect of their carbon dioxide ammonia content. In the first case a batch of plates containing the same depth of the same medium was inoculated with the fungus to be tested. When these cultures had reached a certain age, a second batch of plates of the same size, but without inoculation, was inverted over each culture of the first batch, the lids being removed. After one or two days' exposure, all the plates of the second batch were removed and inoculated with the same or another fungus and the growth in a given time, usually two days, determined. The results showed that a considerable amount of staling takes place in the medium in exposed plates, but this effect soon disappears if the plates are left for some time with the lids off before inoculation. Deep plates of medium are more slowly staled than shallow plates of the same medium.

In the second series of experiments, the amounts of ammonia generated in *Sphaeropsis* cultures on a number of media were determined, and experiments were carried out to show how far the